

An exciting hobby.... for everyone

# everyday electronics

MAY 72

15p

40c

# FREE! INSIDE ▶

... A POCKET GUIDE TO  
**CONSTRUCTIONAL  
ELECTRONICS**

Australia 40c  
New Zealand 40c  
South Africa 35c  
Rhodesia 35c  
West Africa 3/6d  
Sweden Kr. 3.00





# ADCOLA Soldering Instruments add to your efficiency

## THE NEW 'INVADER'

### ADCOLA L.646

for Factory Bench Line Assembly

A precision instrument—supplied with standard 3/16" (4.75 mm) diameter, detachable copper chisel-face bit\*.

Standard temp. 360°C at 23 watts.

Special temps. from 250°C—410°C.

PRICE  
£1.85

#### \*Additional Stock Bits (illustrated) available

##### COPPER

B 38  $\frac{1}{8}$ " — 3.2 mm CHISEL FACE

B 14  $\frac{3}{16}$ " — 2.4 mm CHISEL FACE

B 24  $\frac{1}{4}$ " — 4.75 mm SCREWDRIVER FACE

B 12  $\frac{1}{8}$ " — 4.75 mm EYELET BIT

B 58  $\frac{1}{2}$ " — 6.34 mm CHISEL FACE

##### LONG LIFE

B 42 LL  $\frac{1}{4}$ " — 4.75 mm CHISEL FACE

B 38 LL  $\frac{1}{8}$ " — 3.2 mm CHISEL FACE

B 14 LL  $\frac{3}{16}$ " — 2.4 mm CHISEL FACE

B 44 LL  $\frac{1}{4}$ " — 4.75 mm SCREWDRIVER FACE

Don't take chances. We don't. All our ADCOLA Soldering Instruments are of impeccable quality. You can depend on ADCOLA day after day. That's why they're so popular. You get consistent good service... reliability... from our famous thermally controlled ADCOLA Element and the tough steel construction of this ideal production tool.

\*  
Write for  
price list  
and  
catalogue



**ADCOLA PRODUCTS LTD.,**  
(Dept. Y), ADCOLA HOUSE, GAUDEN RD., LONDON, S.W.4.  
Telephone: 01-622 0291/3 • Telegrams: Soljoint London Telux • Telex: Adcola London 21851

# SAFEBLOC

## of robust construction

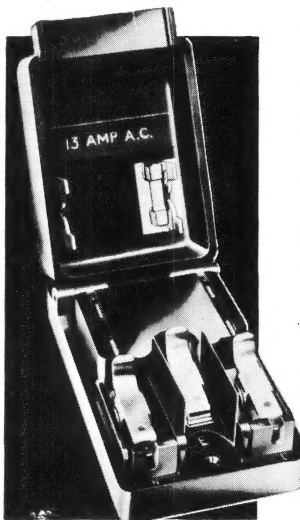
Safe, quick and secure it connects 2-core and 3-core bare-ended flexible leads to the mains (A.C. only).

The concept was pioneered by Rendar, and introduced to the market 13 years ago.

Safebloc saves time. No need to fit a plug for tests. No danger, as no current can pass with the lid open.

Invaluable for testing and demonstrations in industry and shops, the work bench and the home.

Ask for Safebloc at your local stockist — or you can order it direct from the manufacturer.



If ordering by post, send cash with order.

PRICE £2.60+10p P.&P. EACH

Special bulk order wholesale and industrial rates on application



# RENDAR®

Rendar Instruments Ltd., Victoria Road,  
Burgess Hill, Sussex. Tel. Burgess Hill 2642

### BARGAIN PRINTED CIRCUIT OFFER

Circuit Board with all holes drilled,  $7\frac{1}{2}$ " x  $5\frac{1}{2}$ " inc. central hole  $1\frac{1}{2}$ " for speaker magnet and cut out for PP9 batt.; 3 L.F.S., Osc. Coil, Ferrite rod with coils and holder, Potentiometer and knob; Circuit Booklet showing component values and positions. All for £1.75 (25p Post). Worth £5.

### BATTERY CHARGER

$5\frac{1}{2}$ " x  $3$ " x  $3$ " with fixing feet; 12V 2Amp. On-off Indicator, 2 yds. Mains and 2 yds. Battery Leads; Battery Clips. £1.50 (25p. Post).  
**PANEL METERS**—70mm square. Minus 10A. to Plus 20A. D.C. £1 (15p Post); Ditto 0-25V. A.C. and D.C. £1 (15p. Post);  $2\frac{1}{2}$ " dia. 0-40V. D.C. 50p (15p Post); **ELECTROSTATIC VOLTMETER**  $3\frac{1}{2}$ " dia. 0-1000V. £2 (15p Post).

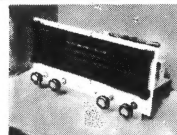
### STEREO AMPLIFIER Type SHV—2 x 3 watts

Fully built. Separate vol., bass and treble controls each channel;  $12 \times 4\frac{1}{2}$ " x 6in high. EZ80, EOC83, 2 x ECL86 valves. O.P. trans. for 3-ohm speakers. Double wound mains trans. Suitable for crystal, magnet cartridge, tuner, etc. 200-250V. A.C. mains. £7. 50p P. & P.



### MONO GRAM CHASSIS 3 WATT

3 Wave band long-med.-short, Gram., 200-250V. A.C. Ferrite aerial. Chassis  $13 \times 7 \times 6$ in. Dial  $13 \times 6$ in. Double wound mains transformer 5 valves ECH81, EF89, EBC81, EL84, EZ80. Price £10-68. (37p P. & P.) Output trans. for 3-ohm speaker. Some slightly tarnished at £10 carr. pd.



### MAINS TRANSFORMERS (240-250V input)

Postage in brackets. 6.3V at  $2\frac{1}{2}$ A. 40p (15p)  
280-0-280V 60MA, 6.3V  $2\frac{1}{2}$ A. 6.3V 700mA £1 (27p)  
250V at 50mA and 6.3V at  $1\frac{1}{2}$ A. 50p (20p)  
22V at 1A, 6.3V at 2A and 250V at 50mA. 75p (25p)  
90V at 20mA and 1.4V at 250mA. 50p (15p)  
Deduct 10 per cent from total bill for more than one transformer.

# GLADSTONE RADIO

66 ELMS ROAD, ALDERSHOT, HANTS.

(2 mins. from Station and Buses). FULL GUARANTEE. Aldershot 22240.  
CLOSED WEDNESDAY. S.A.E. for enquiries please.

# Would YOU pay 50 pence for a components catalogue?



**HOME RADIO COMPONENTS LTD.**

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50 new pence (50p)

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**POST THIS COUPON with your cheque or postal order for 70p**



Please write your Name and Address in block capitals

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**HOME RADIO (COMPONENTS) LTD., Dept. EE,**  
 234-240 London Road, Mitcham, Surrey CR4 3HD.



# The Specification sounds fine the System sounds great

## Viscount III Audio Suite complete £49

**14 + 14W per channel 40Hz to 40kHz  $\pm$  3dB Total distortion at 10 watts at 1kHz -0.1%.**

This is real value for money! We have designed 3 systems and the heart of them all is the Viscount III amplifier. A unit of great eye appeal with teak finished cabinet. It is available in 2 versions — R100 for ceramic cartridges, and R101 for magnetic and ceramic. FET's (Field effect transistors) are incorporated on the input stages, just like top priced units. FET's give you more of the signal you want and almost none of the hiss you don't. Both units have output sockets for headphones and tape recorder. Filters and tone controls give a wide range of bass and treble adjustment.

For all systems we have chosen the famous Garrard SP25 Mk. III deck which comes complete with teak finished plinth and perspex cover.

The exclusive Duo loudspeaker systems are incomparable for quality within their price range. Large speakers in extremely substantial cabinets. There's a choice of the Duo II's for the smaller room or the big Duo III's for real bass response.

### PRICES

SYSTEM I	
Viscount III R101 amplifier	£22.00 + 90p p&p
2 x Duo Type II speakers	£14.00 + £2 p&p
Garrard SP25 Mk. III with MAG. cartridge plinth and cover	£23.00 + £1.50 p&p
<b>Total</b>	<b>£59.00</b>

### Available complete for only £52 + £3.50 p&p

SYSTEM 2	
Viscount R101 amplifier	£22.00 + 90p p&p
2 x Duo Type III speakers	£32.00 + £3 p&p
Garrard SP25 Mk. III with MAG. cartridge, plinth and cover	£23.00 + £1.50 p&p
<b>Total</b>	<b>£77.00</b>

### Available complete for only £69 + £4 p&p

SYSTEM 3	
Viscount III Amplifier R100	£17.00 + 90p p&p
2 x Duo Type II speakers, pair	£14.00 + £2 p&p
Garrard SP25 Mk. III with CER. diamond cartridge, plinth and cover	£21.00 + £1.50 p&p
<b>Total</b>	<b>£52.00</b>

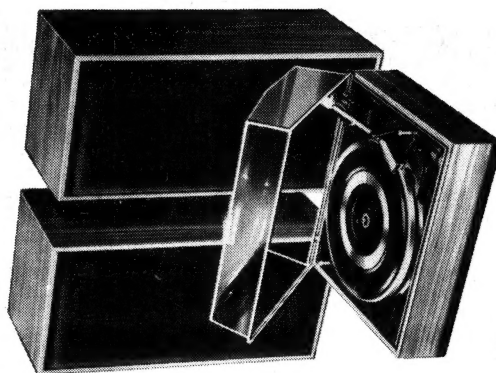
### Available complete for only £49 + £3.50 p&p

### SPEAKERS Duo Type II

Size approx. 17" x 10 $\frac{1}{2}$ " x 6 $\frac{1}{2}$ ". Drive unit 13" x 8" with parasitic tweeter. Max. power 10 watts, 3 ohms. Simulated Teak cabinet. **£14 pair + £2 p&p.**

Duo Type III. Size approx. 23 $\frac{1}{2}$ " x 11 $\frac{1}{2}$ " x 9 $\frac{1}{2}$ ". Drive unit 13 $\frac{1}{2}$ " x 8 $\frac{1}{2}$ " with H.F. speaker. Max. power 20 watts at 3 ohms. Freq. range 20Hz to 20kHz. Teak veneer cabinet. **£32 pair + £3 p&p.**

**SPECIFICATION R101**  
14 watts per channel into 3 to 4 ohms. Total distortion @ 10W @ 1kHz 0-1%. P.U.1 (for ceramic cartridges) 150mV into 3 Meg. P.U.2 (for magnetic cartridges) 4mV @ 1kHz into 47K, equalised within  $\pm$ 1dB R.I.A.A. Radio 150mV into 220K. (Sensitivity given at full power). Tape out facilities: head-phones socket, power out 250mW per channel. Tone controls and filter characteristics. Bass: +12dB to -17dB @ 60Hz. Bass filter: 6dB per octave cut. Treble control: treble +12dB to -12dB @ 15kHz. Treble filter: 12dB per octave. Signal to noise ratio: (all controls at max) R101—P.U.1 and radio—65dB. P.U.2 —58dB. R100 same as R101 but P.U.2 (for crystal cartridges) 450mV into 3 Meg. Cross talk better than -35dB on all inputs. Overload characteristics better than 26dB on all inputs. Size approx 13 $\frac{1}{2}$ " x 9" x 3 $\frac{1}{2}$ ".



Goods not despatched outside U.K.



Radio and TV Components (Acton) Ltd.,  
21c High Street, Acton, London W3 6NG,  
323 Edgware Road, London, W2. Mail orders  
to Acton. Terms C.W.O. All enquiries S.A.E.



**FOR  
RAPID  
SERVICE**

# GARLAND BROS. LTD.

DEPTFORD BROADWAY, LONDON, SE8 4QN

## TRANSISTORS

AC127	17p	BFX29	38p
AC128	18p	BFX84	25p
AC176	22p	BFY88	30p
AC187	22p	BFY50	21p
AC188	27p	BFY51	21p
ACY19	23p	BFY52	22p
AD149	47p	MAT100	25p
AD161/162	72p	MAT101	29p
ADT140	62p	MAT120	29p
AF116	45p	MAT121	29p
AF124	22p	OC28	58p
AF125	19p	OC35	48p
AF126	20p	OC44	12p
AF127	19p	OC45	12p
AF178	67p	OC71	11p
AF179	45p	OC72	12p
AF180	45p	OC75	20p
AF239	32p	OC200	27p
BC107	11p	OC201	38p
BC108	11p	OC271	60p
BC109	11p	ST140	15p
BC147	12p	ST141	15p
BC148	12p	UT46	35p
BC149	12p	2N696	15p
BC157	15p	2N706A	15p
BC158	14p	2N2926G	14p
BC159	14p	2N2926Y	13p
BD131	75p	2N2926O	12p
BD132	75p	2N3053	25p
BF115	25p	2N3054	60p
BF178	32p	2N3055	72p
BF179	56p	2N3702	15p
BF180	30p	2N3703	14p
BF181	32p	2N3704	15p
BF184	30p	2N3705	14p
BF185	32p	2N3706	14p
BF194	14p	2N3711	14p
BF195	14p	2N3819	35p
BF196	28p	2N4058	17p
BF197	15p	2N4549	60p
BFW10	70p		

## DIODES

AA119	11p	OA202	10p
OA47	71p	BY100	15p
OA90	71p	BY127	22p
OA91	6p	BYZ12	22p

## ZENER DIODES

From 2 to 33 volts.  
400mW, 15p; 1.5W, 22p

## SILICON BRIDGE RECTIFIERS

40 P.I.V., 1.5A  
200 P.I.V., 2.0A **50p**

## FUSES AND HOLDERS

1 1/2 in glass—21p  
60, 100, 150, 250, 500, 750mA; 1, 1.25, 1.5, 2, 2.5, 3, 5, 7.5, 10, 15 amp.  
3 1/2 in glass—24p  
100, 250, 500mA; 1, 1.5, 2, 3 amp.  
Anti-surge 1 1/2 in—8p  
250, 500, 750, 850mA; 1, 1.5, 2, 3 amp.  
Anti-surge 20mm—5p  
80, 125, 200, 315, 400, 500, 630, 800mA; 1, 2 amp.

## PANEL FUSEHOLDERS

For 1 1/2 in fuses 18p  
For 20mm fuses 15p

## CONTROLS, Log. or Lin.

Single, less switch, 15p  
Single, D.P. switch, 24p  
Tandem, less switch, 40p  
5kΩ, 10kΩ, 25kΩ, 50kΩ, 100kΩ, 250kΩ, 500kΩ, 1MΩ, 2MΩ

## RESISTORS

Carbon  
All 5%, high-stability, E12 values.  
1/4W, 11p; 1W, 4p; 2W, 6p  
Wire-wound  
5W, 10p; 10W, 12p

## ELECTROLYTICS

1μF	450V	19p	1,000μF	25V	27p
2μF	500V	20p	1,000μF	50V	39p
4μF	350V	14p	2,000μF	25V	36p
8μF	450V	16p	2,000μF	50V	53p
16μF	450V	17p	2,500μF	25V	45p
15μF	50V	8p	2,500μF	50V	60p
32μF	450V	24p	3,000μF	25V	48p
50μF	50V	10p	5,000μF	25V	55p
100μF	25V	10p	5,000μF	50V	98p
250μF	25V	12p	8-16μF	450V	20p
250μF	50V	17p	16-16μF	450V	27p
500μF	25V	18p	16-32μF	450V	63p
500μF	50V	25p	32-32μF	450V	49p
			50-50μF	350V	38p

## MINIATURE ELECTROLYTICS

1μF	25V	10μF	64V
2.5μF	64V	16μF	40V
4μF	40V	25μF	25V
5μF	64V	30μF	15V
8μF	15V	50μF	15V
8μF	40V	100μF	15V
10μF	15V		

## ALUMINIUM BOXES with lids and screws

Type	Length	Width	Depth	Price
GB7*	2 1/2 in	4 1/2 in	1 1/2 in	38p
GB8*	4 in	4 in	1 1/2 in	38p
GB9*	4 in	2 1/2 in	1 1/2 in	38p
GB10*	4 in	5 1/2 in	1 1/2 in	44p
GB11	4 in	2 1/2 in	2 in	38p
GB12	3 in	2 in	1 in	33p
GB13	6 in	4 in	2 in	52p
GB14	7 in	5 in	2 1/2 in	63p
GB15	8 in	6 in	3 in	81p
GB16	10 in	7 in	3 in	92p

\* These sizes fit standard Veroboard

## VEROBOARD

Size	0-1 matrix	0-15 matrix
2 1/2 in x 3 1/2 in	22p	16p
2 1/2 in x 5 in	24p	25p
3 1/2 in x 3 1/2 in	24p	25p
3 1/2 in x 5 in	27p	29p
1 7/8 in x 2 1/2 in	75p	57p
1 7/8 in x 3 1/2 in	£1	75p

Pins—both sizes; packet of 36, 18p

## VARIABLE POWER SUPPLY

Input: 240V, a.c.  
Output: Switched 3, 4.5, 6, 7.5, £4-20  
9, 12 volts d.c. at 500mA

## CASSETTE OWNERS!

For Philips and similar cassette recorders.  
PU12 Power unit for connection to 12V + or -  
— E car electrical systems, £3-25  
giving 7 1/2V, stabilised output.

PP75 Mains power supply, output 7 1/2V d.c.  
Both units are complete with cable and 5 pin D.I.N. plug £1-95

## BONDED ACRYLIC FIBRE

B.A.F. wadding, 18 in wide, 1 in thick. The ideal lining for speaker enclosures. 25p per yard

## MISCELLANEOUS ITEMS

B9A valve bases, 2p  
5kΩ edge control, fits most small, imported radios, 7p  
20Ω volume control for 3Ω speakers, 20p  
Antex CN240, 15W miniature soldering iron, £1-70  
Valve and Transistor Data book, 9th edition, 75p  
Transistor equivalent book, BPI, 40p

## LOW-OHM RESISTORS

2 1/2 watt wire-wound, 1Ω, 1-8Ω, 2-7Ω, 3-3Ω, 3-9Ω, 4-7Ω, 5-6Ω, 6-8Ω, 8-2Ω **11p**

## CAPACITORS

2.2pF	500V	S/M	7 1/2p	0.0027μF	500V	S/M	15p
3.3pF	500V	S/M	7 1/2p	0.003μF	500V	P.S.	5p
5pF	500V	S/M	7 1/2p	0.0033μF	125V	Cer.	6p
10pF	500V	S/M	7 1/2p	0.0033μF	500V	Poly.	6p
10pF	500V	S/M	7 1/2p	0.0033μF	1,000V	MDC	6p
15pF	500V	S/M	7 1/2p	0.0047μF	125V	P.S.	15p
15pF	500V	P.S.	5p	0.0047μF	500V	Poly.	6p
15pF	500V	Cer.	4p	0.0047μF	500V	S/M	20p
18pF	500V	S/M	7 1/2p	0.0047μF	1,000V	MDC	6p
22pF	125V	P.S.	5p	0.005μF	100V	Mylar	3p
22pF	500V	S/M	7 1/2p	0.005μF	500V	Cer.	3p
25pF	500V	S/M	7 1/2p	0.0056μF	125V	P.S.	10 1/2p
27pF	500V	Cer.	5p	0.0068μF	500V	S/M	30p
33pF	125V	P.S.	5p	0.0068μF	500V	Poly.	6p
33pF	500V	S/M	7 1/2p	0.0082μF	125V	P.S.	10 1/2p
39pF	500V	S/M	7 1/2p	0.0082μF	500V	S/M	30p
47pF	125V	P.S.	5p	0.01μF	12V	Disc	4p
47pF	500V	S/M	7 1/2p	0.01μF	125V	P.S.	10 1/2p
50pF	500V	S/M	7 1/2p	0.01μF	160V	Poly.	3p
56pF	500V	S/M	7 1/2p	0.01μF	250V	M.F.	3p
68pF	125V	P.S.	5p	0.01μF	400V	Poly.	3p
68pF	500V	S/M	7 1/2p	0.01μF	500V	Cer.	5p
75pF	500V	S/M	7 1/2p	0.01μF	500V	S/M	30p
82pF	500V	Cer.	5p	0.01μF	600V	MDC	7p
100pF	125V	P.S.	5p	0.01μF	1,000V	MDC	9p
100pF	500V	S/M	7 1/2p	0.015μF	160V	Poly.	3p
100pF	500V	Cer.	5p	0.015μF	400V	Poly.	3p
120pF	500V	S/M	7 1/2p	0.02μF	100V	Mylar	3p
150pF	125V	P.S.	5p	0.022μF	18V	Disc	5p
150pF	500V	S/M	7 1/2p	0.022μF	250V	M.F.	3p
150pF	500V	Cer.	5p	0.022μF	400V	Poly.	3p
180pF	500V	S/M	7 1/2p	0.022μF	600V	MDC	7 1/2p
200pF	500V	S/M	7 1/2p	0.022μF	1,000V	MDC	9p
220pF	125V	P.S.	5p	0.033μF	250V	M.F.	4p
220pF	500V	Cer.	5p	0.033μF	400V	Poly.	4p
250pF	500V	S/M	8p	0.047μF	12V	Disc	6p
270pF	500V	Cer.	5p	0.047μF	160V	Poly.	3p
300pF	500V	S/M	8p	0.047μF	250V	M.F.	3p
330pF	125V	P.S.	5p	0.047μF	400V	Poly.	4p
330pF	500V	S/M	8p	0.047μF	600V	MDC	8p
390pF	500V	S/M	8p	0.047μF	1,000V	MDC	10p
470pF	125V	P.S.	5p	0.1μF	30V	Disc	6p
470pF	750V	Disc	5p	0.1μF	250V	M.F.	4p
500pF	500V	S/M	8p	0.1μF	400V	Poly.	4p
560pF	500V	S/M	8p	0.1μF	600V	MDC	10p
680pF	125V	P.S.	6p	0.1μF	1,000V	MDC	13p
680pF	500V	S/M	8p	0.15μF	250V	M.F.	3p
820pF	500V	S/M	8p	0.22μF	160V	Poly.	6p
0.001μF	100V	Mylar	3p	0.22μF	250V	M.F.	5p
0.001μF	125V	P.S.	6p	0.22μF	400V	Foil	10p
0.001μF	400V	Poly.	3p	0.22μF	1,000V	MDC	15p
0.001μF	500V	S/M	10p	0.33μF	250V	M.F.	8p
0.001μF	500V	Cer.	5p	0.47μF	250V	Foil	8p
0.001μF	1,000V	MDC	6p	0.47μF	400V	Foil	15p
0.0015μF	400V	Poly.	3p	0.47μF	1,000V	MDC	20p
0.0015μF	500V	S/M	10p	1.0μF	250V	M.F.	15p
0.0018μF	500V	S/M	10p				
0.002μF	100V	Mylar	3p				
0.002μF	500V	Cer.	5p				
0.0022μF	125V	P.S.	6p				
0.0022μF	500V	S/M	10p				
0.0022μF	1,000V	MDC	6p				

Note:  
S/M=silver mica 1% tol.  
P.S.=polystyrene 2 1/2% tol.  
MDC—ac. rating=300V.  
M.F.=Mullard min. foil.  
Cer.=ceramic.

## PLUGS

Car aerial	14p
Co-axial	8p
D.I.N. 2 pin (speaker)	10p
D.I.N. 3 pin	13p
D.I.N. 4 pin	14p
D.I.N. 5 pin, 180°	13p
D.I.N. 5 pin, 240°	15p
D.I.N. 6 pin	15p
Jack, 2 1/2mm unscreened	9p
Jack, 2 1/2mm screened	10p
Jack, 3 1/2mm unscreened	8p
Jack, 3 1/2mm screened	12p
Jack, 4 1/2mm unscreened	12p
Jack, 4 1/2mm screened	20p
Jack, stereo, unscreened	20p
Jack, stereo, screened	35p
Phono, plastic top	5p
Phono, plated metal	12p
Phono, fitted 4 ft lead	8p
Wander, red or black	3p
Banana 4mm, red or black	6p

## LINE SOCKETS

Car aerial	14p
Co-axial	8p
D.I.N. 2 pin (speaker)	10p
D.I.N. 3 pin	13p
D.I.N. 4 pin	14p
D.I.N. 5 pin, 180°	13p
D.I.N. 5 pin, 240°	15p
Jack, 2 1/2mm	9p
Jack, 3 1/2mm	10p
Jack, 4 1/2mm	10p
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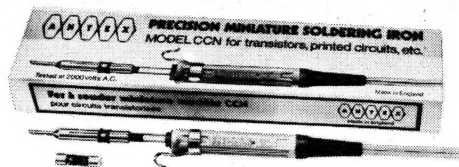




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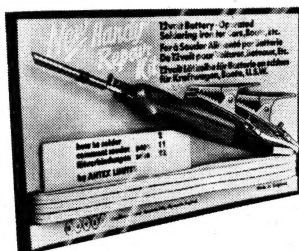
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2N1302	10p	2N3710	13p	40602	52p
2N1303	19p	2N3711	13p	40669	140p
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2N1305	28p	2N3724	15p	AC126	20p
2N1306	33p	2N3819	28p	AC127	20p
2N1307	33p	2N3820	53p	AC128	27p
2N1308	36p	2N3904	35p	AC141H	34p
2N1309	36p	2N3906	35p	AC141HK	27p
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2N2218A	44p	2N4126	27p	*AC187K/188K	27p
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2N2219A	53p	2N4286	15p	ACY17	31p
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C	1/8W	5%	4.7 Ω-470K Ω	E24	1	0.8	0.7
C	1/4W	10%	4.7 Ω-10M Ω	E12	1	0.8	0.7
C	1/2W	5%	4.7 Ω-10M Ω	E24	1.2	1	0.9
C	1W	10%	4.7 Ω-10M Ω	E12	2.5	2	1.8
W	1/2W	2%	10 Ω-1M Ω	E24	4	3.5	3
W	1W	10% ±1/20 Ω	0.22 Ω-3 Ω	E12	7	7	6
W	3W	5%	12 Ω-10K Ω	E12	7	7	6
W	7W	5%	12 Ω-10K Ω	E12	9	9	8

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LP3 3" 250'	P.V.C.	28p	LP8 5½" 1200'	P.V.C.	75p
TT3 3" 450'	POLYESTER	37p	DT6 5½" 1800'	POLYESTER	£1-12
DT3 3½" 600'	POLYESTER	57p	TT6 5½" 2400'	POLYESTER	£1-87
SP5 5" 600'	P.V.C.	42p	SP7 7" 1200'	P.V.C.	62p
LP5 5" 900'	P.V.C.	50p	LP7 7" 1800'	P.V.C.	75p
DT5 5" 1200'	POLYESTER	75p	DT7 7" 2400'	POLYESTER	£1-25
			TT7 7" 3600'	POLYESTER	£2-50

TAPE SPOOLS 3" 5p, 5½" 7p, 7" 9p.  
Post and Packing 3" 5p, 5½" 8p, 7" 10p (3 reels and over Post Free).



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**Rogers Ravensbrook II Stereo Amplifier in teak case (List £52-50) £38-50**

**Rogers Ravensbourne Stereo Amplifier in teak case (List £64) £49-00**

**Metrosound ST20E Stereo Amplifier in teak case (List £39-50) £28-50**

**Thorens TD150A/II turntable with arm £31-00**

**Garrard SP25 III with Goldring G800 cartridge (List £28-35) £15-50**

## SP25 MKIII SPECIAL!



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P. & P. 50p.

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**Garrard 2025 T/C with Stereo Ceramic Cartridge £9-97**

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(As used in SYSTEM "ONE" above)

A truly high quality stereo amplifier—compare the specification, compare the price. Output: 5 watts per channel. Frequency response: 30-20,000 Hz = 2 db. Distortion: 1%. Output Impedance 8 ohms nom. Inputs equalised to R.I.A.A. Magnetic 4mV. Ceramic 100mV. Tuner 100mV. Tape 100mV. Tape out 150mV. Din sockets for inputs and outputs. Controls: Bass, Treble, Volume, Balance, Selector, Mono/Stereo switch. Stereo headphone socket. Attractive slim line design black leatherette cabinet with aluminium front panel. Size 12½" x 6½" x 2½".

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Designed to the highest possible standard. Fitted 2½in. speaker units with soft padded ear muffs. Adjustable headband. 8 ohms impedance. Complete with 6ft lead and stereo jack plug. £2-47 P. & P.

**STEREO STETHOSCOPE SET** Low imp. £1-25 P. & P. 10p  
**MONO STETHOSCOPE SET** Low imp. 52p. P. & P. 10p



## E.M.I. 13x8in. HI-FI SPEAKERS

Fitted two 2½in tweeters and crossover network. Impedance 8 or 15 ohm. Handling capacity 15W. Brand new. £3-47 P. & P. 40p

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**MONO MODEL £3** **STEREO MODEL £3.47** P. & P. 15p



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C90 (90 min.)	62p	3 for £1-80
C120 (120 min.)	87p	3 for £2-55

P. & P. 5p.

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Garrard SL65B	£13.25
Garrard 401	£27.00
Garrard Zero 100 (Auto)	£39.95
Garrard Zero 100 (Single)	£37.25
Garrard SL72B	£24.00
Garrard SL75B	£26.00
Garrard SL95B	£35.00
BSR MP60	£10.00
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Goldring GL72/P	£29.25
Goldring GL75/P	£27.50
Wharfedale Linton & cart.	£27.75
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Thorens TD125AB	£90.00
Thorens TD150 Mk. II	£28.00
Thorens TD150A Mk. II	£33.75

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Please add 75p P. & P.

Amstrad 9000 Mk. II	£16.95
Amstrad IC2000	£27.90
Armstrong 521 (teak cased)	£43.95
Alpha Highgate 212	£25.00
Alpha Highgate FA300	£27.95
Alpha Highgate FA400	£31.95
Cambridge P100	£65.95
Cambridge P40	£65.95
Cambridge P50	£71.00
Ferrograph F307 Mk. II	
(Wood cased)	£47.50
Ferrograph F307 Mk. II	
(Metal cased)	£45.00
Leak Delta 30	£48.00
Leak Delta 70	£56.00
Metrosound ST20E	£24.75
Metrosound ST60	£47.25
Pioneer SA600	£58.00
Pioneer SA700	£66.50
Pioneer SA800	£73.95
Pioneer SA900	£92.00
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Rogers R/brook (Cased)	£37.00
Rogers R/brook (Cased)	£41.50
Rogers R/brook (Cased)	£46.50
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Sinclair PRO60 2 x Z30/PZ6	£17.50
Sinclair PRO60 2 x Z30/PZ8/Trans	£21.75
Sinclair AFU (Filter Unit)	£4.40
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Sinclair 3000 Mk. II	£29.75
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Sugden A51/CS1	£102.00
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Goodmans Max Amp	£37.95
Teleton SAQ306B	£21.50
Teleton SAQ306B	£22.95
Euromphon 10 + 10	£16.95

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Please add 75p P. & P.

Armstrong 253	£39.50
Armstrong 524	£31.00
Rogers Ravensbrook FET4 (Chassis)	£31.00
Rogers Ravensbrook FET4 (Cased)	£35.00
Rogers Ravensbourne FET4 (Chassis)	£43.00
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Sinclair PRO60 (Module)	£18.50
Sinclair Cased Tuner	£24.00
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Leak Delta FM (Cased)	£55.50
Leak Delta AM/FM (Cased)	£66.50

## TUNER/AMPLIFIERS

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Philips RH882 (+cass head)	£72.00
Philips RH702	£82.50
Teleton 2100	£29.95
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Rogers R/brook (Teak)	£80.00
Rogers R/brook (Chassis)	£74.50

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Please add £1.25 P. & P. per pair

Amstrad 138	£20.00
Wharfedale Denton 2	£29.00
Wharfedale Linton 2	£37.00
Wharfedale Linton 2	£47.95
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AC127	25p	BF173	19p	MPF104	37p	OC203	40p	2N1309	30p
AC128	20p	BF177	25p	MPF105	40p	OC204	40p	2N1507	28p
AC151	12p	BF178	31p	NKT124	30p	OC205	75p	2N1613	15p
AC162	15p	BF180	35p	NKT125	40p	OC206	90p	2N1711	15p
AC153	19p	BF181	35p	NKT126	37p	OC207	75p	2N2147	75p
AC176	25p	BF184	20p	NKT128	25p	OC211/M	42p	2N2148	60p
AC187	25p	BF185	25p	NKT211	25p	ORP12	50p	2N2160	57p
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AD162	38p	BF251	19p	NKT281	29p	V405A	46p	2N3053	20p
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AF114	25p	BF253	17p	NKT404	60p	ZTX109	18p	2N3055	60p
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AF118	25p	BSX19	19p	NKT452	54p	ZTX303	18p	2N3703	10p
AF117	25p	BSX20	19p	NKT453	54p	ZTX304	18p	2N3704	11p
AF118	44p	BSX21	20p	OA5	20p	ZTX314	11p	2N3705	10p
AF124	25p	BSY27	20p	OA10	25p	ZTX320	30p	2N3706	9p
AF126	17p	BSY29	25p	OA47	8p	ZTX330	18p	2N3707	11p
AF139	30p	BSY95A	12p	OA70	8p	ZTX300	18p	2N3708	7p
AF186	40p	BY100	15p	OA73	8p	ZTX501	16p	2N3709	9p
AF239	38p	BY127	15p	OA79	8p	ZTX502	20p	2N3710	9p
AF279	47p	BY210	35p	OA81	8p	ZTX503	17p	2N3711	9p
AS226	25p	BY212	30p	OA85	8p	ZTX504	40p	2N3819	35p
AS227	30p	BY213	20p	OA90	8p	IN914	7p	2N3820	60p
AS228	22p	BZY88		OA91	8p	IN4001	7p	2N3826	30p
AS229	30p	C3V3	15p	OA95	8p	IN4002	7p	2N4058	15p
AS221	87p	C3V6	15p	OA200	10p	IN4803	10p	2N4060	12p
BC107	10p	C3V9	15p	OA202	10p	IN4004	10p	2N4061	12p
BC108	10p	C4V3	15p	OC19	37p	IN4005	12p	2N4062	12p
BC109	10p	C4V7	15p	OC20	97p	IN4006	15p	2N4289	15p
BC147	10p	C5V1	15p	OC22	47p	2N5756	95p	2N4871	40p
BC148	8p	C5V6	15p	OC23	60p	IN4007	20p	2N5245	45p
BC149	10p	C5V7	15p	OC24	60p	IN4008	7p	40950	55p
BC158	11p	C5V8	15p	OC25	37p	2G302	19p	40959	38p
BC167	11p	C7V5	15p	OC26	38p	2G371	15p	40910	45p
BC168	10p	C8V2	15p	OC28	60p	2G374	25p	40912	45p
BC169	11p	C9V1	15p	OC29	60p	2N174	80p	40920	47p
BC169C	15p	C10	15p	OC35	60p	2N385A	50p	40930	43p
BC183	10p	C11	15p	OC36	60p	2N388A	50p	40961	47p
BC182L	10p	C12	15p	OC41	25p	2N404	25p	40962	55p
BC183	9p	C13	15p	OC42	30p	2N696	15p	40406	58p
BC183L	10p	C15	15p	OC44	15p	2N697	17p	40407	38p
BC184	13p	C16	15p	OC45	12p	2N698	30p	40408	51p
BC184L	12p	C18	15p	OC71	12p	2N706	10p	40409	54p
BC212	12p	C20	15p	OC72	12p	2N708A	12p	40410	62p
BCY30	25p	C22	15p	OC75	25p	2N709	18p	40468A	35p
BCY31	48p	C24	15p	OC76	25p	2N711	37p	40600	58p
BCY32	50p	C27	15p	OC77	40p	2N711A	37p	40601	55p
BCY33	50p	C30	15p	OC81	20p	2N911	50p	40602	40p
BCY38	20p	CR1/051C	40p	OC81D	20p	2N914	20p	40603	49p
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BCY71	30p	CR83/40AF	£1.08	OC83	25p	2N1131	30p	40512	£1.45
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BD124	75p	MD520	50p	OC139	25p	2N1302	17p		
BD131	75p	MJ480	97p	OC140	30p	2N1303	17p		
BD132	75p	MJ481	£1.05	OC170	30p	2N1304	28p		
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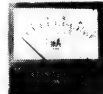
### CLEAR PLASTIC METERS



**TYPE SW.100**  
100 x 80 mm.

500μA	...	\$3.60	20V D.C.	...	\$3.10
50-0-500μA	...	\$3.45	50V D.C.	...	\$3.10
100μA	...	\$3.20	300V D.C.	...	\$3.10
100-0-100μA	...	\$3.45	1 amp. D.C.	...	\$3.10
500μA	...	\$3.35	5 amp. D.C.	...	\$3.10
1mA	...	\$3.10	VU Meter	...	\$3.75

### BAKELITE PANEL METERS



**TYPE S-80**  
80 mm. square fronts

500μA	...	\$3.20	50V D.C.	...	\$3.60
50-0-500μA	...	\$3.10	300V D.C.	...	\$3.60
100μA	...	\$2.75	1 amp. D.C.	...	\$3.60
100-0-100μA	...	\$3.10	5 amp. D.C.	...	\$3.60
500μA	...	\$3.00	300V A.C.	...	\$3.60
1mA	...	\$2.60	VU Meter	...	\$3.37

## "SEW" CLEAR PLASTIC METERS

**Type MR.52P. 4 1/2in. x 4 1/2in. fronts.**



500μA	...	\$3.60	20V D.C.	...	\$3.80
50-0-500μA	...	\$3.10	50V D.C.	...	\$3.80
100μA	...	\$3.60	300V D.C.	...	\$3.80
100-0-100μA	...	\$3.60	1 amp. D.C.	...	\$3.80
500μA	...	\$3.60	5 amp. D.C.	...	\$3.80
1mA	...	\$3.60	30 amp. D.C.	...	\$3.80

**Type MR.52P. 2 1/2in. square fronts.**

500μA	...	\$3.10	10V D.C.	...	\$3.00
50-0-500μA	...	\$2.60	20V D.C.	...	\$3.00
100μA	...	\$2.60	50V D.C.	...	\$3.00
100-0-100μA	...	\$2.60	300V D.C.	...	\$3.00
500μA	...	\$2.60	15V A.C.	...	\$2.10
1mA	...	\$2.60	300V A.C.	...	\$2.10

**Type MR.52P. 3 1/2in. x 4 1/2in. fronts.**

500μA	...	\$3.37	10V D.C.	...	\$3.20
50-0-500μA	...	\$2.75	20V D.C.	...	\$3.20
100μA	...	\$2.75	50V D.C.	...	\$3.20
100-0-100μA	...	\$2.65	300V D.C.	...	\$3.20
500μA	...	\$2.40	15V A.C.	...	\$2.30
500-0-500μA	...	\$2.30	150V A.C.	...	\$2.30
1mA	...	\$2.20	300V A.C.	...	\$2.30
5mA	...	\$2.20	500V A.C.	...	\$2.30
10mA	...	\$2.20	8 Meter 1mA	...	\$2.37
50mA	...	\$2.20	VU Meter	...	\$3.37
100mA	...	\$2.20	500mA A.C.	...	\$2.30
500mA	...	\$2.20	1000mA A.C.	...	\$2.30
1 amp.	...	\$2.20	2000mA A.C.	...	\$2.30
5 amp.	...	\$2.20	500mA A.C.*	...	\$2.30
10 amp.	...	\$2.20	500mA A.C.*	...	\$2.30
15 amp.	...	\$2.20	1 amp. A.C.*	...	\$2.30
20 amp.	...	\$2.20	5 amp. A.C.*	...	\$2.30
30 amp.	...	\$2.30	10 amp. A.C.*	...	\$2.30
50 amp.	...	\$2.30	20 amp. A.C.*	...	\$2.30
5V D.C.	...	\$2.20	30 amp. A.C.*	...	\$2.30

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100μA	...	\$4.65	50V d.c.	...	\$4.40
1mA	...	\$4.40	300V d.c.	...	\$4.40
50-0-500μA	...	\$4.65			
1-0-1mA	...	\$4.40	Dual range		
1A d.c.	...	\$4.40	500mA/5A d.c.	...	\$4.65
5A d.c.	...	\$4.40	5V/50V d.c.	...	\$4.65
10V d.c.	...	\$4.40			

## "SEW" BAKELITE PANEL METERS

**Type MR.55. 3 1/2in. square fronts.**



25μA	...	\$3.50	1 amp.	...	\$1.95
50μA	...	\$3.50	2 amp.	...	\$1.95
50-0-500μA	...	\$3.35	5 amp.	...	\$1.95
100μA	...	\$3.35	15 amp.	...	\$1.95
100-0-100μA	...	\$3.25	30 amp.	...	\$1.95
500μA	...	\$3.20	50 amp.	...	\$1.95
1mA	...	\$1.95	5V D.C.	...	\$1.95
1-0-1mA	...	\$1.95	10V D.C.	...	\$1.95
5mA	...	\$1.95	20V D.C.	...	\$1.95
10mA	...	\$1.95	50V D.C.	...	\$1.95
50mA	...	\$1.95	150V D.C.	...	\$1.95
100mA	...	\$1.95	300V D.C.	...	\$1.95
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			VU Meter	...	\$3.10

## EDGWISE METERS

**Type PE.70. 3 1/2in. x 1 1/2in. x 2 1/2in. deep.**

50μA	...	\$3.10	600μA	...	\$2.75
50-0-500μA	...	\$3.00	1mA	...	\$2.45
100μA	...	\$3.00	300V A.C.	...	\$2.45
100-0-100μA	...	\$2.90	VU Meter	...	\$3.40
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Send for illustrated brochure on SEW Panel Meters—discounts for quantities.

# MULTIMETERS for EVERY purpose!



**MODEL LT-101** 1000 O.P.V. 0/10/50/250/1000 V. D.C. 0/10/50/250/1000 V. A.C. 0/1/100 M.A. 0/150 K ohms. \$1.97. P. & P. 15p.



**MODEL FL486** 20K Ω/Volt D.C. 8k Ω/Volt A.C. Mirror scale. -0/3/12/30/120/600V D.C. 3/30/120/600V A.C. 500mA/600mA/600 mA, 10/100K/1200 V. 1 Meg/10 Meg Ω. -20 to +46db. \$8.97. P. & P. 12p.



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**ROUND SCALE TYPE PENCIL TESTER MODEL TS.68** Completely portable, simple to use pocket sized tester. Ranges 0/3/30/300V A.C. and DC at 2000 Ω/v. Resistance > 20K Ω ohm. FET \$1.97 P. & P. 13p



**TMK MODEL 117 F.E.T. ELECTRONIC VOLTMETER** Battery operated, 11 meg input, 26 ranges. Large 4 1/2" mirror scale. Size 5 1/2" x 4 1/2" x 2 1/2". DC VOLTS 0-3 1200V. AC VOLTS 3-300V RMS. 8-0 800V P-P. DC CURRENT 12-12mA. Resistance up to 2000K ohm. Decibels -20 to +51 db Complete with leads/instructions. \$17.50. P. & P. 20p.



**TE-20D RF SIGNAL GENERATOR** Accurate wide range signal generator covering 120 Kc/s-500 Mc/s on 6 bands. Directly calibrated Variable R.F. attenuator, audio output. Xtal socket for calibration. 220/240V. A.C. Brand new with instructions. \$15. Carr. 37p. Size 140 x 215 x 170 mm.



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**MODEL TE-200** 20,000 O.P.V. Mirror scale, overload protection. 0/5/25/125/1,000V. D.C. 0/10/50/250/1,000V. A.C. 0/50/500/5,000mA. 12 amp. D.C. 0/60K/6 meg Ω. P. & P. 15p.



**TMK MODEL MD.120** Mirror scale. 20K/Volt D.C. 10K Ω Volt A.C. 50/300/600/3,000 V. D.C. 6/120/1,200 V. A.C. Current -0.60A/0 -12/0 300mA. 0-0.60K/0-6 Meg Ω. -20 to +63 db. \$4.62. P. & P. 15p.



**MODEL 500** 30,000 O.P.V. with overload protection mirror scale 0/5/2.5/10/25/100/250/500/1,000 V. D.C. 0/2.5/10/25/100/250/500/1,000V. A.C. 0/500A/5/50/500mA. 12 amp. D.C. 0/60K/6 meg Ω. P. & P. 15p.



**TMK LAB TESTER.** 100,000 O.P.V. 6 1/2in. Scale Buzzer Short Circuit Check. Sensitivity: 100,000 O.P.V. D.C. 5K/Volt A.C. D.C. Volts: -5, -2.5, 10, 250, 1,000 V. A.C. Volts: 3, 10, 50, 50, 250, 500, 1,000V. D.C. Current: 10, 100A, 10, 100, 500mA, 2.5, 10 amp. Resistance: 1K, 10K, 100K, 10MEG Ω. Decibels: -10 to +49 db. Plastic Case with Carrying Handle. Size 7 1/2in. x 6 1/2in. x 3 1/2in. \$18.90. P. & P. 25p



**U431S MULTIMETER** Extremely sturdy instrument for general electrical use. 667 o.p.v. 0/3/1-5/7.5/30/60/150/300/600/900 VDC and 75mV. 0/3/1-5/7.5/30/60/150/300/600/900 VAC. 0/300mA/1-5/6/150/60/180/600mA/1-5/6 AMP. D.C. 0/1-5/6/15/60/150/600mA/1.5/6 AMP. AC. 0/200 Ω/3K/30K Ω. Accuracy DC 1%. AC 1-5%. Knife, edge pointer, mirror scale. Complete with sturdy metal carrying case, leads and instructions. \$5.50 plus P. & P. 25p.



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**HONEYWELL DIGITAL VOLTMETER VT.100** Can be panel or bench mounted. Basic meter measures 1 volt D.C. but can be used to measure a wide range of AC and DC volt, current and ohms with optional plug in cards. Specification: Accuracy: ± 0.2, ± 1 digit. Resolution: 1mV. Number of digits: 3 plus fourth overrange digit. Overrange: 100% (up to 1.999). Input impedance: 1000 Meg ohm. Measuring cycle: 1 per second. Adjustment: Automatic zeroing, full scale adjustment against an internal reference voltage. Overload: to 100V. D.C. Input: Fully floating (3 poles). Input power: 110-230V. A.C. 50/60 cycles. Overall size: 5 1/2in. x 2 1/2in. x 8 1/2in. AVAILABLE BRAND NEW AND FULLY GUARANTEED AT APPROX. HALF PRICE. \$49.97. Carr. 50p.



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2G306	42p	2N3564	17p	2B301	50p	BC121	80p	BFX30	25p	NKT237	35p
2G308	30p	2N3565	15p	2B302	50p	BC122	80p	BFX31	30p	NKT238	25p
2G309	30p	2N3566	15p	2B303	50p	BC123	80p	BFX32	30p	NKT240	25p
2G371	15p	2N3585	25p	2B304	75p	BC126	20p	BFX68	67p	NKT241	25p
2G374	20p	2N3589	25p	2B501	33p	BC134	12p	BFX84	25p	NKT242	20p
2G381	22p	2N3570	125p	2B502	33p	BC385	12p	BFX85	30p	NKT243	62p
2N388A	40p	2N3572	97p	2B503	27p	BC136	15p	BFX86	25p	NKT244	17p
2N404	20p	2N3605	27p	2B508	40p	BC137	15p	BFX87	25p	NKT245	20p
2N405	20p	2N3606	27p	2B509	40p	BC138	15p	BFX88	25p	NKT246	20p
2N697	15p	2N3607	22p	2N140	77p	BC140	35p	BFX89	80p	NKT263	30p
2N698	25p	2N3638	18p	2N141	72p	BC141	35p	BFX93A	70p	NKT264	20p
2N699	30p	2N3638A	20p	2N142	55p	BC142	10p	BFY11	20p	NKT271	20p
2N706	10p	2N3641	18p	2N143	67p	BC148	10p	BFY18	25p	NKT262	20p
2N706A	10p	2N3642	18p	2N152	87p	BC149	12p	BFY19	25p	NKT274	20p
2N708	30p	2N3643	18p	2N153	87p	BC150	12p	BFY24	25p	NKT275	20p
2N709	60p	2N3644	22p	2N250	50p	BC153	20p	BFY29	25p	NKT276	20p
2N712	20p	2N3645	25p	2N251	32p	BC154	20p	BFY29	20p	NKT281	27p
2N713	30p	2N3691	15p	2N309	32p	BC171	15p	BFY31	40p	NKT401	87p
2N726	30p	2N3692	15p	2N310	45p	BC158	11p	BFY41	50p	NKT402	90p
2N727	30p	2N3693	15p	2N311	35p	BC159	12p	BFY43	62p	MKT403	76p
2N734	17p	2N3694	15p	2N312	47p	BC160	30p	BFY45	20p	NKT404	62p
2N916	20p	2N3703	9p	2N314	37p	BC170	10p	BFY51	20p	NKT405	75p
2N918	30p	2N3703	10p	2N315	37p	BC168B	10p	BFY52	20p	NKT406	62p
2N929	22p	2N3704	11p	2N316	47p	BC168C	11p	BFY53	15p	NKT451	62p
2N930	20p	2N3705	11p	2N317	37p	BC169B	11p	BFY66A	57p	NKT452	62p
2N987	40p	2N3706	9p	2N319	55p	BC169C	12p	BFY76	42p	NKT453	47p
1N1090	20p	2N3707	11p	2N320	47p	BC170	12p	BFY77	57p	NKT713	20p
1N1091	20p	2N3708	9p	2N321	47p	BC171	12p	BFY78	57p	NKT714	20p
2N1131	25p	2N3709	9p	2N324	47p	BC172	25p	BXS19	17p	NKT734	27p
2N1132	25p	2N3710	9p	2N326	37p	BC175	25p	BXS20	15p	NKT736	35p
2N1302	17p	2N3711	12p	2N329	30p	BC177	20p	BXS21	20p	NKT773	25p
2N1303	17p	2N3713	187p	2N344	27p	BC178	20p	BXS26	45p	NKT781	30p
1N1304	22p	2N3714	200p	2N347	57p	BC179	20p	NKS27	47p	OC16	50p
2N1305	25p	2N3715	18p	2N348	27p	BC180	20p	NKS28	45p	OC20	75p
2N1306	25p	2N3716	130p	2N360	40p	BC182L	10p	BXS60	82p	OC20	75p
2N1307	25p	2N3723	240p	2N361	40p	BC183	9p	BXS61	62p	OC22	50p
2N1308	25p	2N3791	200p	2N362	50p	BC183L	9p	BXS76	15p	OC23	60p
2N1309	25p	2N3819	34p	2N370	32p	BC184	11p	BXS77	20p	OC24	60p
2N1507	17p	2N3820	55p	2N406	57p	BC184L	11p	BXS78	25p	OC25	40p
2N1508	17p	2N3823	25p	2N407	57p	BC185	11p	BXS79	25p	OC26	40p
2N1631	30p	2N3855	27p	2N408	55p	BC187	25p	BYS25	15p	OC28	25p
2N1632	35p	2N3854A	27p	2N409	55p	BC121L	12p	BYS26	17p	OC29	60p
2N1637	30p	2N3855	27p	2N410	62p	BC213L	12p	BYS27	15p	OC35	50p
2N1638	27p	2N3855A	30p	2N412	50p	BC214L	15p	BYS28	17p	OC36	50p
2N1639	27p	2N3866	30p	2N467A	57p	BC219	20p	BYS29	27p	OC41	22p
2N1701	162p	2N3856A	35p	2N484	30p	BC220	20p	BYS32	25p	OC42	22p
2N1711	162p	2N3857	35p	2N485	30p	BCY31	30p	BYS33	25p	OC43	22p
2N1889	32p	2N3858A	30p	2N4600	57p	BCY32	30p	BYS37	25p	OC45	12p
2N1893	37p	2N3859	27p	2N4603	50p	BCY33	25p	BYS38	20p	OC46	15p
2N2147	72p	2N3859A	32p	2N4707	30p	BCY34	30p	BYS39	22p	OC71	15p
2N2160	72p	2N3860	30p	2N4726	30p	BCY38	30p	BCY43	30p	OC71	15p
2N2193	40p	2N3866	150p	2N4727	30p	BCY39	30p	BYS35	25p	OC72	15p
2N2194	40p	2N3867	150p	2N4728	30p	BCY40	30p	BYS36	25p	OC73	15p
2N2194	40p	2N3877A	40p	2N4731	18p	BCY41	15p	BYS53	37p	OC74	30p
2N2194A	40p	2N3900	37p	2N4732	22p	BCY42	15p	BYS54	40p	OC75	22p
2N2217	25p	2N3900A	40p	2N4734	22p	BCY43	15p	BYS56	90p	OC76	22p
2N2218	20p	2N3901	97p	2N4735	20p	BCY54	32p	BYS79	45p	OC77	30p
2N2219	20p	2N3903	20p	2N4736	25p	BCY58	25p	BYS80	57p	OC78	20p
2N2220	20p	2N3904	20p	2N4737	25p	BCY58	25p	BYS81	57p	OC79	20p
2N2221	20p	2N3905	30p	2N4738	25p	BCY58	25p	BYS95A	12p	OC80	20p
2N2222	25p	2N3906	25p	2N4739	27p	BCY60	7p	C424	15p	OC81D	20p
2N2222A	25p	2N4058	12p	2N4740	24p	BCY70	15p	C450	15p	OC82	25p
2N2297	30p	2N4059	10p	2N4741	20p	BCY71	20p	GET102	10p	OC82D	15p
2N2297	30p	2N4059	10p	2N4742	20p	BCY72	15p	GET113	20p	OC83	25p
2N2368	15p	2N4060	12p	2N4743	20p	BCY78	30p	GET114	20p	OC84	25p
2N2369	15p	2N4061	12p	2N4744	20p	BCY79	30p	GET115	20p	OC85	25p
2N2369A	15p	2N4062	12p	2N4745	17p	BCZ10	27p	GET120	25p	OC140	32p
2N2410	42p	2N4244	47p	2N4746	47p	BCZ11	40p	GET873	13p	OC170	25p
2N2483	27p	2N4248	15p	2N4749	20p	BD112	50p	GET880	30p	OC171	30p
2N2484	32p	2N4249	15p	2N4751	15p	BD116	112p	GET887	20p	OC200	40p
2N2539	22p	2N4250	18p	2N4754	22p	BD121	62p	GET889	22p	OC201	60p
2N2540	22p	2N4251	18p	2N4755	22p	BD122	62p	GET890	22p	OC202	60p
2N2613	30p	2N4255	42p	2N4759	47p	BD124	60p	GET896	22p	OC203	60p
2N2614	30p	2N4284	17p	2N4760	62p	BD131	75p	GET897	22p	OC204	40p
2N2646	25p	2N4285	17p	2N4761	35p	BD132	80p	GET898	22p	OC205	75p
2N2711	40p	2N4286	17p	2N4762	35p	BDY10	125p	MAT100	25p	OC206	95p
2N2712	25p	2N4287	17p	2N4769	45p	BDY20	105p	MAT101	32p	OC207	75p
2N2713	27p	2N4713	15p	2N4770	15p	BDY21	105p	MAT102	32p	OC208	75p
2N2714	27p	2N4714	15p	2N4771	15p	BDY22	105p	MAT103	32p	OC209	75p
2N2715	27p	2N4715	15p	2N4772	15p	BDY23	105p	MAT104	32p	OC210	75p
2N2716	27p	2N4716	15p	2N4773	15p	BDY24	105p	MAT105	32p	OC211	75p
2N2904	20p	2N4290	12p	2N4774	15p	BDY25	105p	MAT106	32p	OC212	75p
2N2904A	25p	2N4291	15p	2N4775	20p	BF115	25p	MJ400	107p	ORP60	42p
2N2905	25p	2N4292	15p	2N4776	20p	BF117	27p	MJ420	80p	ORP61	42p
2N2905A	25p	2N4293	15p	2N4777	20p	BF152	28p	MJ421	80p	PT440	22p
2N2905A	25p	2N4294	17p	2N4778	20p	BF154	28p	MJ430	102p	ST140	15p
2N2906	20p	2N4303	47p	2N4779	22p	BF158	15p	MJ440	95p	ST141	20p
2N2906A	20p	2N4304	47p	2N4780	22p	BF159	15p	MJ450	95p	ST142	20p
2N2907	22p	2N4365	18p	2N4781	22p	BF163	35p	NK181	125p	TS843	40p
2N2923	15p	2N5027	52p	2N4782	16p	BF167	16p	MJ490	100p	TS844	10p
2N2924	15p	2N5028	57p	2N4783	28p	BF170	33p	MJ491	137p	TS845	27p
2N2925	15p	2N5029	47p	2N4784	42p	BF173	30p	MJ5340	50p	TS846	11p
2N2926C	10p	2N5030	42p	2N4785	45p	BF177	30p	ME8780	80p	TS847	11p
2N2927	10p	2N5031	42p	2N4786	45p	BF178	30p	ME8781	80p	TS848	11p
2N2927C	10p	2N5032	42p	2N4787	45p	BF179	30p	ME8782	80p	TS849	11p
2N2927C	10p	2N5033	42p	2N4788	45p	BF180	30p	ME8783	80p	TS850	11p
2N3011	20p	2N5175	52p	2N4789	45p	BF181	30p	ME8784	80p	TS851	11p
2N3014	32p	2N5176	45p	2N4790	45p	BF182	30p	ME8785	80p	TS852	11p
2N3053	18p	2N5222A	30p	2N4791	45p	BF183	30p	ME8786	80p	TS853	11p
2N3054	46p	2N5245	45p	2N4792	45p	BF184	30p	ME8787	80p	TS854	11p
2N3055	46p	2N5246	45p	2N4793	45p	BF185	30p	ME8788	80p	TS855	11p
2N3133	20p	2N5249	47p	2N4794	25p	BF194	15p	MPF364	37p	TS856	22p
2N3134	15p	2N5365	325p	2N4795	25p	BF195	15p	NKT121A	42p	ZTX107	15p
2N3135	25p	2N5365	37p	2N4796	24p	BF196	15p	NKT1225	27p	ZTX108	12p
2N3136	25p	2N5366	40p	2N4797	27p	BF197	15p	NKT1226	27p	ZTX109	15p
2N3390	25p	2N5307	37p	2N4798	25p	BF198	15p	NKT1228	27p	ZTX300	12p
2N3391	25p	2N5308	37p	2N4799	25p	BF199					

## Integrated Circuits

Integrated Circuits		FJH111	70p	SN7430	20p
		FJH121	25p	SN7440	20p
		FJH131	25p	SN7441AN	
CA3000	180p	FJH141	25p		75p
CA3005	117p	FJH151	25p	SN7442	75p
CA3007	202p	FJH161	70p	SN7443	100p
CA3010	85p	FJH171	25p	SN7447	75p
CA3012	85p	FJH181	25p	SN7448	125p
CA3013	105p	FJH221	25p	SN7450	20p
CA3014	184p	FJH231	25p	SN7451	20p
CA3018	84p	FJH241	25p	SN7453	20p
CA3018A	10p	FJH251	25p	SN7454	20p
		IC10	25p	SN7460	20p
CA3019	110p	FJH111	50p	SN7472	40p
CA3020	126p	FJH121	60p	SN7473	40p
CA3020A		FJH131	60p	SN7474	40p
		FJH141	125p	SN7475	40p
CA3021	180p	FJH151	75p	SN7477	40p
CA3022	180p	FJH191	25p	SN7483	87p
CA3023	126p	FJH211	125p	SN7486	33p
CA3026	100p	FJH251	125p	SN7490	87p
CA3028A	74p	FJL101	125p	SN7492	87p
CA3028B		FY101	25p	SN7493	87p
		IC12	25p	SN7494	87p
CA3029	87p	IC12	25p	SN7496	87p
CA3029A		L900	40p	SN74107	52p
	185p	L914	40p	SN74153	
CA3030	137p	L923	40p		135p
CA3035	128p	LM380	125p	SN74154	
CA3036	180p	MC7400	200p		200p
CA3039	85p	MC780P	125p	SN74160	
CA3041	100p	MC788P	140p		180p
CA3042	100p	MC790P	125p	SN74161	
CA3043	137p	MC792P	60p		
CA3044	126p	MC799P	68p	SN74164	220p
CA3045	180p	MC1303L			200p
CA3046	81p		200p	SN74165	
CA3047	137p	MC1304P		225p	
CA3048	204p		225p	SN74192	
CA3049	180p	MC1305P			175p
CA3050	185p		58p	SN74193	
CA3051	180p	MC838P	340p		175p
CA3052	185p	MC1451P	34p	TAA241	162p
CA3053	40p		34p	TAA242	
CA3054	140p				
CA3055	240p	MC1552G			425p
CA3059	185p		70p	TAA243	
CA3060	180p	MC1709GP		TAA263	75p
FCH111	85p		94p	TAA293	97p
FCH101	105p	MFC4000P		TAA300	175p
FCH121	105p		25p	TAA310	125p
FCH131	50p		85p	TAA320	72p
FCH141	105p	PA230	20p	TAA330	100p
FCH151	105p	PA234	92p	TAA435	147p
FCH171	105p	PA237	210p	TAA521	132p
FCH181	105p	PA246	150p	TAA522	380p
FCH191	105p	PA424	235p	TAA530	405p
FCH201	130p	PA464	190p	TAA511	445p
FCH211	105p	PA405	100p	TAA512	445p
FCH221	130p	SN7400	20p	TAD110	150p
FCH231	150p	SN7401	20p	TAD110	150p
FCJ101	180p	SN7402	20p	SL4033	15 p
FCJ111	150p	SN7403	20p	SL702C	147p
FCJ121	875p	SN7404	20p	U7022A	280p
FCJ131	875p	SN7405	20p	U7023A	280p
FCJ141	875p	SN7406	20p	U7070S	137p
FCJ201	875p	SN7407	20p	U7090C	45p
FCJ211	875p	SN7409	20p	U7106	125p
FCJ211	875p	SN7410	20p	U7107	125p
FCJ211	875p	SN7411	23p	U7108	125p
FCJ211	875p	SN7412	23p	U7109	125p
FJH101	25p	SN7420	20p	U7430C	160p
				U7431C	80p

## BRIDGE

<b>BRIDGE</b>		50 PIV 4A	<b>40p</b>
<b>RECTIFIERS</b>		100 PIV 4A	<b>50p</b>
<b>PLASTIC</b>		200 PIV 4A	<b>55p</b>
<b>ENCAPSULATED</b>		400 PIV 4A	<b>65p</b>
		600 PIV 4A	<b>70p</b>
600 PIV 1A	<b>50p</b>	50 PIV 6A	<b>45p</b>
50 PIV 2A	<b>45p</b>	100 PIV 6A	<b>55p</b>
100 PIV 2A	<b>50p</b>	200 PIV 6A	<b>65p</b>
200 PIV 2A	<b>55p</b>	400 PIV 6A	<b>75p</b>
400 PIV 2A	<b>60p</b>	600 PIV 6A	<b>85p</b>

**SILICON RECTIFIERS**  
**MINIATURE WIRE ENDED PLAST**

SERIES	IN	PL	CL
	1 AMP	1.5 AMP	3 AMP
4001 50PIV	7p	8p	19p
4002 100PIV	7p	8p	20p
4003 200PIV	8p	10p	22p
4004 400PIV	8p	10p	25p
4005 600PIV	10p	12p	28p
4006 800PIV	12p	15p	27p
4007 1000PIV	15p	18p	30p

50 + less 15%    100 + less 20%

SILICON RECTIFIERS				
STUD MOUNTING				
	6A	10A	17-5A	35A
100PIV	—	45p	50p	\$1.22
200PIV	25p	50p	55p	\$1.42
400PIV	30p	55p	62p	\$1.77
600PIV	32p	60p	72p	\$2.12
800PIV	35p	75p	87p	\$2.47
1000PIV	40p	85p	\$1.05	\$2.77

50+ less 15% 100+ less 20%

ZENER DIODES		
400MW	1.5 WATT	10 WATT
3.3-33 V	2.4-100	3.9-100V
10p each	25p each	40p each
25 + less 15% 100 + less 20%		

**TRANSISTOR DISCOUNTS:-** 12 + 10%;  
25 + 15%; 100 + 20% any one type. Post-  
age on all Semi Conductors 7p extra.  
**S.A.E. FOR FULL LISTS.**

**VALVES**

VALVES					
0A2	38p	25Z4	30p	EL85	35p
0B2	45p	25Z5	42p	EM80	45p
0Z4	30p	25Z6	65p	EM81	60p
1L4	20p	30C15	80p	EM84	35p
1B5	45p	30C16	80p	EM85	21-00
1S5	30p	30C18	80p	EM87	70p
1T4	25p	30F5	85p	EY51	40p
1U4	30p	30FL1	75p	EY86	40p
1U5	60p	30FL12	120p	EY87	42p
2D21	35p	30FL14	80p	EZ40	55p
2D22	35p	30LL15	85p	EZ41	55p
2E4	35p	30L17	80p	EZ42	27p
3V4	48p	30C18	80p	EZ81	28p
5R4	75p	30P19	85p	GZ32	29p
5U4	35p	30PL1	75p	GZ34	60p
5V4	45p	30PL13	93p	KT66	22-05
5Y3	40p	30PL14	40p	KT58	22-00
6A4	35p	30P15	85p	PC86	40p
6/30L2	80p	35W34	35p	PACB80	40p
6AC7	40p	35Z4	35p	PC86	60p
6AG7	40p	35Z5	50p	PC88	60p
6AK5	35p	50B5	50p	PC97	45p
6AK6	60p	50C5	50p	PC90	48p
6AM6	35p	50A2	55p	PC96	45p
6AQ3	38p	807	50p	PC88S	40p
6AS6	40p	1625	50p	PC88S	55p
6AT6	35p	5763	70p	PCCL189	50p
6AU6	25p	6146	180	PCF84	34p
6B6	30p	AZ31	55p	PCF82	30p
6B7	35p	5763	70p	PCF84	30p
6BE6	30p	DAF91	30p	PCF86	60p
6BH6	75p	DAF96	45p	PCF800	50p
6BJ6	50p	DF91	22p	PCF801	50p
6BQ7A	40p	DF96	45p	PCF802	50p
6BR7	90p	DK91	40p	PCF805	75p
6BQ7	35p	DF92	30p	PCF806	50p
6BW6	85p	DK96	50p	PCF808	80p
6BW7	80p	DL92	35p	PCL82	35p
6BZ6	40p	DL94	45p	PCL83	65p
6C4	38p	DL96	45p	PCL84	45p
6CD6	125p	DM70	40p	PCL85	40p
6C6	65p	DT86	32p	PCF84	40p
6CW4	65p	DT87	30p	PF1200	65p
6F1	62p	EB8CC	100p	PL86	55p
6F6G	35p	EB18F	100p	PL81	50p
6F13	45p	EACB80	35p	PL82	45p
6F14	70p	EAF42	35p	PL83	45p
6F15	65p	EB91	20p	PL84	40p
6F16	85p	EAF11	110p	PL80	40p
6F23	85p	EB8C1	30p	PL504	80p
6F6	16p	EB8F80	40p	PY32	50p
6J4	50p	EB8F83	40p	PY33	63p
6J5	25p	EBF89	32p	PY80	40p
6J5GT	30p	EBL21	60p	PY81	30p
6K6	25p	EB8F80	40p	PY82	30p
6J7	45p	EC88	60p	PY83	38p
6K8G	40p	EC40	65p	PY88	40p
6LG6T	40p	EC8C4	30p	PY800	40p
6LD20	40p	EC8C5	40p	PY801	50p
6M7	40p	EC8C8	40p	U25	80p
6N47	40p	ECF80	35p	U50	40p
6N7	40p	ECF82	35p	U50	40p
68J7	40p	ECF86	65p	U52	35p
68K7	40p	ECHE21	70p	U191	75p
68L7	35p	ECI835	100p	U281	40p
68N7	35p	ECI42	75p	U282	40p
68P7	40p	ECI81	30p	U301	40p
68Q7	40p	ECI83	30p	U301	41-00
6V6	25p	EC1L80	45p	UABCS0	40p
6V6GT	32p	EC1L82	35p	UAF42	55p
6X4	35p	EC1L83	70p	UBC41	50p
6X5G	30p	EC1L86	40p	UBC81	40p
6X5GT	40p	EF37A	120p	UBF80	40p
6Y0	35p	EF37B	120p		
10F1	75p	EF40	40p	UC84	40p
10P13	60p	EF41	65p	UC85	40p
10P14	21-10	EF42	70p	UCF80	55p
12A7E	30p	EF80	25p	UCH21	60p
12A7	30p	EF85	35p	UCH42	70p
12A7	30p	EF86	30p	UCH81	60p
12A7	30p	EF89	30p	UCH22	35p
12A7E	30p	EF91	30p	UCL83	60p
12BA6	40p	EF92	35p	UF41	60p
12BE6	40p	EF183	35p	UF80	35p
12BH7	45p	EF184	35p	UF85	40p
19AQ5	35p	EH90	40p	UF99	40p
20F1	30p	EL24	40p	UG41	75p
20F2	30p	EL33	21-25	UL84	40p
20P1	21-10	EL41	60p	UY41	48p
20P1	50p	EL42	65p	UY85	40p
20P3	60p	EL81	55p	VR150/30	38p
20P4	21-10	EL84	25p	VR150/30	45p
20P6	21-10	EL85	45p	Add 12p in £	
25L6	50p	EL91	35p	for postage	
DIODES & RECTIFIERS					
1N34A	10p	BA154	12p	6J7M	37p
1N34	10p	BA155	12p	6A3	17p
1N916	10p	BA166	7p	7O	12p
AA119	7p	BAY31	7p	7O10	22p
AA129	10p	BAY38	15p	9A	09p
AA213	10p	BY100	15p	0A47	8p
AA215	10p	BY103	22p	0A70	40p
BA100	10p	BY104	15p	0A73	10p
BA102	30p	BY124	15p	0A79	7p
BA110	25p	BY126	12p	0A81	8p
BA111	27p	BY127	15p	0A85	7p
BA112	70p	BY164	42p	0A90	7p
BA115	7p	BY210	35p	0A91	7p
BA141	10p	BY214	40p	0A95	7p
BA142	32p	BY212	30p	0A200	7p
BA144	12p	BY213	25p	0A202	10p
BA145	20p	BY216	40p	0A210	17p

← See previous page

G. W. SMITH & CO. (RADIO) LTD.

See opposite page 5



# HI-FI EQUIPMENT

**SAVE UP TO 33% OR MORE**  
SEND S.A.E. FOR  
DISCOUNT PRICE LISTS  
AND PACKAGE OFFERS!

## RECORD DECKS

<b>BSR</b>	<b>ZERO 100A</b>	<b>£41.85</b>
UA50 Mono†	<b>ZERO 100S</b>	<b>£40.70</b>
CI29†	<b>GOLDRING</b>	
MP60	GL69/2	£18.97
610	GL69/2P	£24.80
510	GL72	£22.25
310	GL72P	£29.05
810	GL75	£29.05
MP60 TPD1	GL75P	£34.95
MP60 TPD2	LID75	£38.88
610 TPD1	LID72	£38.85
210 TPD1	C99	£19.30
210 Package*	GL85	£46.50
HT 70	GL85P	£54.30
HT 70 Package	LID85	£48.80
	G101	£21.95
<b>GARRARD</b>	<b>PIONEER</b>	
2025 TC*	PL12AC	£35.15
40B*	PL15C	£50.25
5-300*	PLA25	£62.85
SP25 III	<b>THORENS</b>	
SL65B	TD125	£57.65
AP76	TD125AB	£91.15
AP76 with	TX15	£6.40
G800*	TD150	£27.90
SL72B	TD150A II	£33.20
SL75B	TD150AB II	£37.80
SL95B	TD150 Plinth	£3.47
401	TX11	£38.65

† Mono \* Stereo Cartridge  
All other models less Carriage  
Carriage 50p extra any model.

## RECORD DECK PACKAGES

Decks supplied with cartridge ready wired in teak veneer plinth with cover.	
Garrard 2025TC/9TAHCD	£12.95
Garrard SP25 III/9TAHCD	£15.95
Garrard SP25 III/G800	£19.50
Garrard SP25 III/M75-6	£20.35
Garrard SP25 III/M44-7	£20.35
Garrard SP25 III/M65-E	£22.30
Garrard SP25 III/G800 (Play on Plinth and Cover)	£19.75
Garrard AP76/G800	£29.50
Garrard AP76/M75-6	£30.25
Garrard AP76/M55-E	£32.95
Garrard AP76/M75EJ	£34.90
BSR McDonald MP60/AT55	£19.25
Golding GL72/G800	£34.50
Golding GL75/G800	£39.70
Golding GL75/G800E	£44.15
Carriage 50p any item.	

## \* TRANSISTORISED FM TUNER

6 TRANSISTOR  
HIGH QUALITY  
TUNER. SIZE  
ONLY 6x4x2in.  
3 I.F. stages.  
Double tuned  
discriminator Amp.  
output to feed most  
amplifiers. Operates on 9 V battery. Coverage  
88-108Mc/s. Ready built ready for use. Fan-  
tastic value for money. £8.37†. P. & P. 12p.  
Stereo multiplex adaptors £4.97†.

## NS-1600W STEREO AMPLIFIER

Exceptional  
budget price  
amplifier. All silicon  
transistor. Handsome Walnut  
case. Switched  
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separate balance, volume, treble, bass con-  
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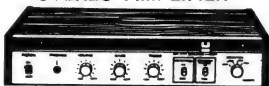
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## TELETON SAQ-206B STEREO AMPLIFIER



Latest exciting release. Brand new model.  
6 + 6 watts rms. Inputs for mag, xtal, aux  
tape. Volume, bass, treble, sliding balance,  
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OUR PRICE £18.50 Carr. 37p.

## TELETON F.2000 AM/FM STEREO TUNER AMPLIFIER



Probably the most popular budget Tuner/  
Amp. and now offered at a ridiculous low  
price. 5 watts r.m.s. per channel. Tape/Cer-  
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● SUGGESTED SYSTEM ●  
F.2000, Garrard 2025TC/Changer fitted  
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pair of G.W.S. Speakers. Total Rec. Price  
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## HA 10 STEREO HEADPHONE AMPLIFIER

All silicon trans-  
istor amplifier op-  
erates from magnetic,  
ceramic or tuner inputs with twin stereo  
headphone outputs and separate volume  
controls for each channel. Operates from 9v  
battery. Inputs 5MU/100MU. Output 50MW.  
£5.97. P. & P. 15p.

## SINCLAIR EQUIPMENT



Project 60. Package offers.  
2 x Z30 amplifier, stereo 60 pre-amp, PZ5  
power supply. £15.95 Carr. 37p. Or with  
PZ6 power supply £18.00 Carr. 37p. 2 x Z50  
amplifier, stereo 60 pre-amp, PZ8 power  
supply. £20.25. Carr. 37p.  
Transformer for PZ8. £2.97† extra.  
Add to any of the above £4.90 for active  
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All other Sinclair products in stock.  
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NEW PROJECT 605 — £20.97, Carr. 37p.

## BH.001 HEAD-SET AND BOOM MICROPHONE

Moving coil. Ideal for  
language teaching, com-  
munications. Headphone  
imp. 16 ohms. Micro-  
phone imp. 200 ohms.  
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## 230 VOLT A.C. 50 CYCLES RELAYS

Brand new. 3 sets of  
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5 amp rating. 50p each.  
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Quantities available.

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Completely self-contained with built-in volt-  
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construction. An essential for colour tele-  
vision servicing. Etc. Size 360mm. long.  
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## SPECIAL OFFER! SINCLAIR PROJECT 60 STEREO FM TUNER



The first tuner in the world to use the phase  
lock loop principle—as used for receiving  
signals from space craft because of its vastly  
improved signal to noise ratio. Provides  
fantastic results even in difficult areas.  
Tuning range 87.5 to 108MHz. Automatic  
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range ± 200KHz. Signal to noise ratio:  
65dB. Output voltage 2 x 150mV. Oper-  
ating voltage 25-30V. D.C. Size: 93 x 40 x  
207 mm. REC. LIST PRICE £25.

ONLY £16.95 P. & P. 25p  
Unrepeatable offer—buy now and save over £8

Model S-100TR MULTI-  
METER/TRANSISTOR  
TESTER 100,000 o.p.v.  
MIRROR SCALE/OVER-  
LOAD PROTECTION  
0/12—6/3/12/30/120/600  
V D.C.  
0/6/30/120/600 V. A.C.  
0/12/600uA/12/300MA/12  
Amp. D.C.  
0/10K/1 MEG/100 MEG.  
—20 to + 50 db. 0.01 — 2 mfd.  
Transistor tester measures Alpha, beta and  
Icc.  
Complete with batteries, instructions and  
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## MCA. 220 AUTO-MATIC VOLTAGE STABILISER

Input 88-125 VAC or 176-  
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£11.97. Carr. 50p.

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Sine 18—200,000 Hz; Square 18—50,000 Hz  
Output max. + 10 dB.  
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Operation in-  
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Attractive 2-  
tone case 7½  
x 5 x 2".  
Price £17.50.  
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TE-16A Transistorised  
Signal Generator. 60 Hz.  
400KHz—30MHz. An  
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for the handyman.  
Operates on 9v battery.  
Wide easy to read scale.  
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Variable range 0-  
111dB. Connections,  
Unbalanced T and  
Bridge T. Impedance 600 Ω range (0.1dB x  
10) + (1dB x 10) + 10 + 20 + 30 + 40dB.  
Frequency: d.c. to 200KHz (—3dB). Accu-  
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Maximum input less than 4W (50V). Built in  
600 Ω load resistance with internal/external  
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## POWER RHEOSTATS

High quality ceramic construction. Windings embedded in  
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## "YAMABISHI" VARIABLE VOLTAGE TRANSFORMERS

Excellent quality. Low price. Immediate delivery

S-260 General Purpose Bench Mounting	S-260B Panel Mounting
1 Amp £7.00	1 Amp £7.00
2.5 Amp £8.05	2.5 Amp £8.05
5 Amp £11.75	Please add postage
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	OUTPUT VARIABLE
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	Special discounts for quantity

## RP214 REGULATED POWER SUPPLY

Solid state. Variable output 0-24V DC up  
to 1 amp. Dual scale meter to monitor  
voltage and current.  
Input 220/240V A.C.  
Size 185 x 85 x  
105mm.  
£39.97  
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# everyday electronics

PROJECTS...  
THEORY....

## FOR ALL SEASONS

Our cover this month has quite an outdoor touch. Of course, you don't have to be an apiarist to sense that things are beginning to buzz in the outside world. Spring is now well advanced and thoughts are likely to be turning towards all kinds of pastimes and occupations for the coming summer months.

It is an appropriate time to point out that do-it-yourself electronics has no closed season. Outdoor activities like gardening, touring, camping, sporting events, and so on, present many unique opportunities for putting electronics to effective use. So we advise, take stock *now*, anticipate your needs and start building to remedy any deficiencies in this respect.

## GOOD COMPANION

The *Constructors Companion* given free with every copy of this month's EVERYDAY ELECTRONICS is small and compact. It has been designed for your pocket, so that wherever you go you can have essential facts constantly at hand. Compiled with the beginner particularly in mind, this booklet will prove a valuable *aide-memoire* for the more experienced constructor as well.

Those still feeling their feet will be glad of the technical back-up they can instantly call upon

when confronted with a choice of allegedly alternative or equivalent parts when shopping personally for components.

## READY ACCESS

Our regular readers will already appreciate the amount of important and useful information they are accumulating, as the months go by. True, not everyone will have an immediate need for every project described. But a word of advice: do not discard back numbers. You never know when circumstances may arise that create a definite need which some previously described project would satisfy exactly.

This leads us on to another common problem: how to store numerous copies of a magazine so that ready access may be made at any time to one particular article. The only really satisfactory solution is to keep copies of the magazine in the binder specially designed to hold 12 issues of EVERYDAY ELECTRONICS and which is now available.



*Our June issue will be published on Friday, May 19*

EDITOR F. E. BENNETT • M. KENWARD • B. W. TERRELL B.Sc.  
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..EASY TO CONSTRUCT  
..SIMPLY EXPLAINED

VOL. 1 NO. 7

MAY 1972

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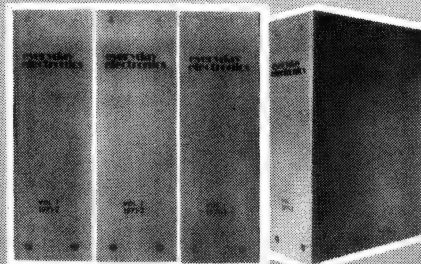
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*Everyday Electronics, May 1972*





# Audio Tone Generator

**BY FRED JUDD**

**This simple tone generator covers the audio range from 50 to 2,000 Hz and has been specifically designed for use with a tape recorder to make electronic music.**

**T**HE multivibrator is one of the most commonly used electronic oscillator circuits and generates an almost square waveform. It can be made to cover a wide frequency range without the need for switching in different values of components and moreover will produce a high output signal level for a relatively small supply voltage. As a primary signal generator it has many uses as a test instrument in audio as well as electronic applications.

The generator described in this article is used as a tone source for the creation of electronic music and "science fiction" sound effects in conjunction with a tape recorder. The feature *Electronic Sounds and Music* on page 363 deals with the use of the tone generator in detail.

## **GENERATOR CIRCUIT**

The circuit diagram is given in Fig. 1 and employs three *pnp* transistors; two of which form the multivibrator (TR1 and TR2), the remaining one, TR3, being used as a squaring amplifier.

The operating frequency and mark to space ratio (see Fig. 2) of the multivibrator are set by the time taken for C2 and C3 to charge up enough to switch transistors TR2 and TR1 respectively. This "charging time" is determined by the value of the capacitor and the value of the resistor through which it is charged.

Providing the time taken for each capacitor to charge is similar then the mark to space



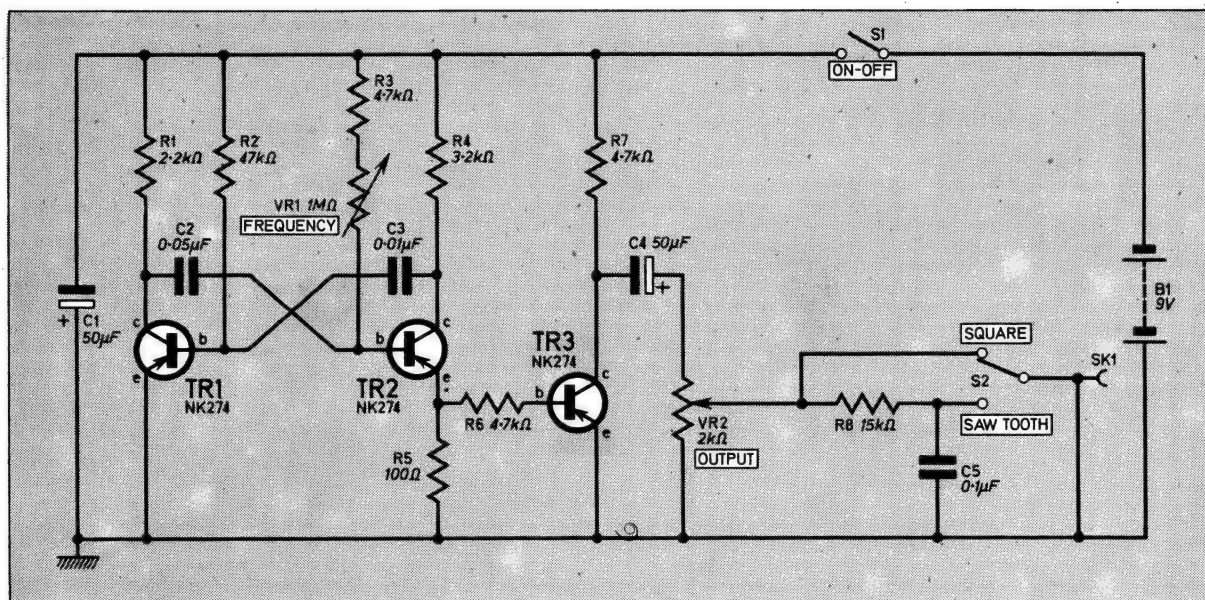


Fig. 1. Complete circuit diagram of the Audio Tone Generator.

ratio will be 1 to 1 or the mark and space will be of similar duration (Fig. 2). If we now change one of the controlling values—in this case VR1—both the frequency and mark to space ratio will be altered.

If we increase the value of VR1 the frequency will decrease as C2 will take longer to charge, and the mark to space ratio will alter for the same reason (see Fig. 3). Thus frequency control is achieved by VR2 and the total frequency range is approximately 50 to 2,000Hz.

The waveform has a mark to space ratio of 1 to 1 at approximately 1,500Hz at all lower frequencies the mark to space ratio increases becoming about 1 to 20 at the lowest frequency (Fig. 3).

The output from the multivibrator is taken from the emitter of TR2, through R6 to the base of TR3. Transistor TR3 is switched hard on and off by the output from TR2 and thus ensures a completely square output at its collector. The output level from TR3 is continuously variable from 0 to approximately 7 volts by VR2.

## SAWTOOTH OUTPUT

The square wave output from TR3 can also be switched via S2 through an integrating network, C5 and R8, to provide an approximately sawtooth waveform (Fig. 4) of about 1 volt peak-to-peak maximum output, instead of the square-wave.

One of the major differences between a square wave and a sawtooth wave is the harmonic content and hence the tonal quality, when either are made audible via an amplifier and loudspeaker. The square wave contains only odd harmonics, in addition to its fundamental,

whereas a sawtooth wave consists of both odd and even harmonics plus the fundamental.

Audibly the square wave has a sound rather like that produced by a clarinet particularly in the region of middle C (261Hz approx.). The sawtooth wave has a sound rather more like a

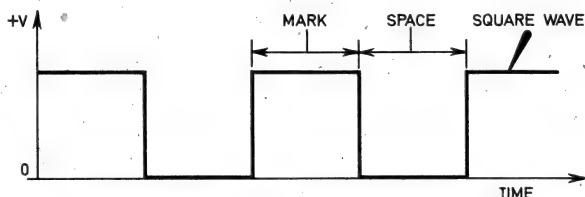


Fig. 2. A square wave with a 1 to 1 mark to space ratio.

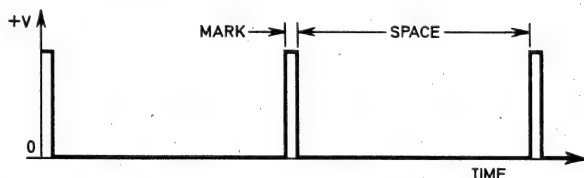


Fig. 3. A square wave with a 1 to 20 mark to space ratio.



Fig. 4. A sawtooth waveform.

# Audio Tone Generator

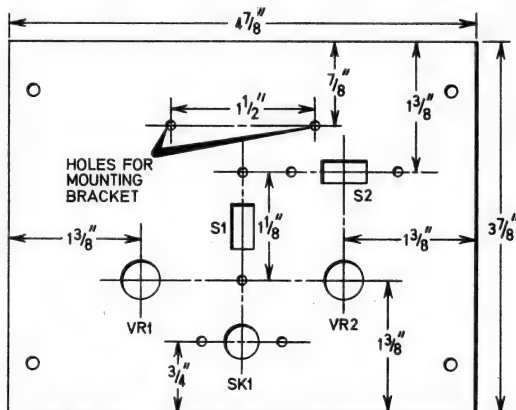
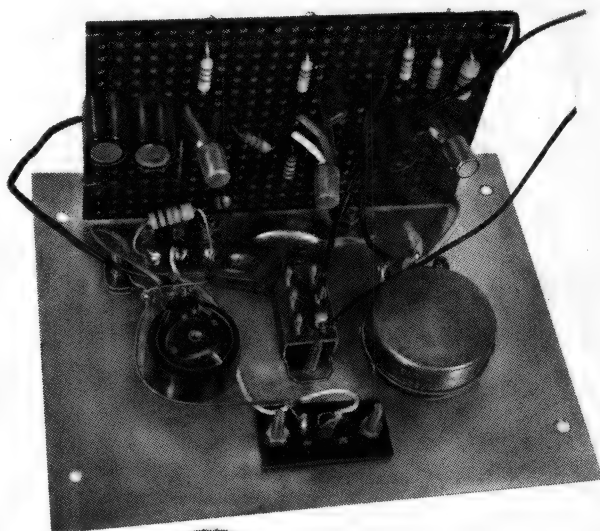
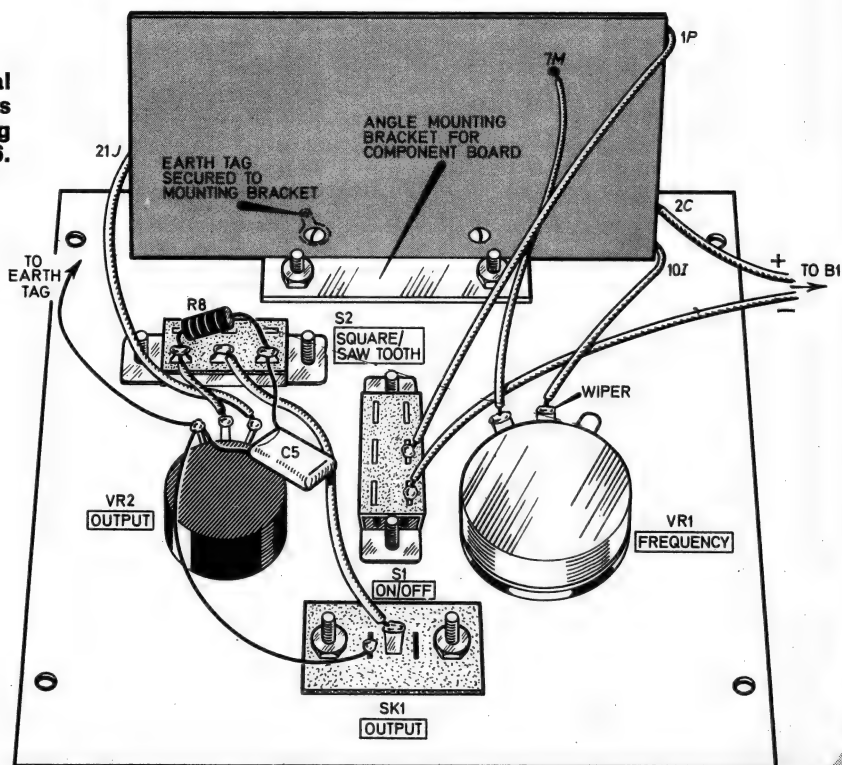


Fig. 5. Front panel drilling details.

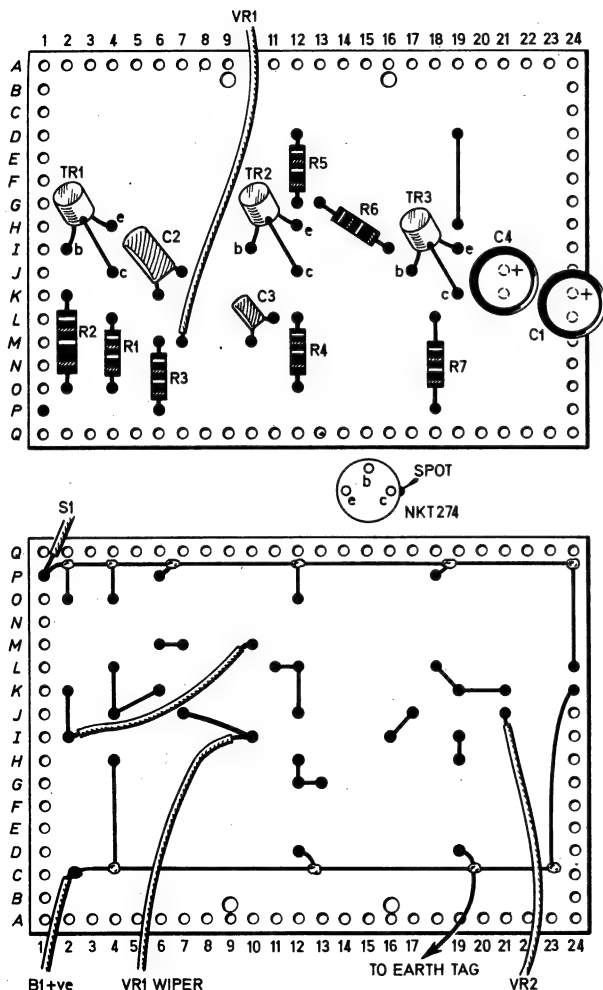


Approximate  
cost of  
components...  
£ 2.60 plus case

Fig. 7. Wiring of the final unit. The tinted area is the component mounting board as shown in Fig. 6.







**Fig. 6. Top and underside views of the component board. The transistor connections between the two diagrams are viewed from the underside.**

flute. Both waveforms are used extensively in electronic organ voicing and for electronic music.

## CONSTRUCTION

The prototype unit was housed in a box made from universal chassis parts. The pieces used assemble into a box measuring 5 by 4 by 3 inches. The sides and top and bottom can be assembled leaving one plate for the front panel and one for the rear. The plate used for the front panel is drilled as shown in Fig. 5 and is used to mount all the components.

If the layout and assembly of the generator is as shown there is just room in the case for a PP9 9 volt battery. Even if you spread the layout a little there should still be room for a slightly smaller 9 volt battery. The circuit board is 0.15 inch matrix plain perforated veroboard and is mounted on a 2 inch length of  $\frac{3}{8}$  by  $\frac{3}{8}$  inch aluminium angle.

## Components....

### Resistors

R1	2.2k $\Omega$
R2	47k $\Omega$
R3	4.7k $\Omega$
R4	3.2k $\Omega$
R5	100 $\Omega$
R6	4.7k $\Omega$
R7	4.7k $\Omega$
R8	15k $\Omega$
All $\frac{1}{4}$ W $\pm 10\%$ carbon	

SEE  
**SHOP  
TALK**

### Capacitors

C1	50 $\mu$ F elect. 12V
C2	0.05 $\mu$ F
C3	0.01 $\mu$ F
C4	50 $\mu$ F elect. 12V
C5	0.1 $\mu$ F

### Transistors

TR1	NKT 274 germanium pnp
TR2	NKT 274 germanium pnp
TR3	NKT 274 germanium pnp

### Potentiometers

VR1	1M $\Omega$ log carbon
VR2	2k $\Omega$ lin carbon

### Switches

S1	S.P.S.T. slide
S2	S.P.D.T. slide

### Miscellaneous

SK1	Phono socket
B1	PP9 9V battery
Control knobs (2 off) Eagle type F10, case 5 x 4 x 3in made from universal chassis panels or a similar size case, battery connector, aluminium angle 2 x $\frac{3}{8}$ x $\frac{3}{8}$ in. Veroboard 5 x 4 x 0.15in matrix plain perforated, earth tag, connecting wire, 4BA fixings.	

Commence wiring of the component board by inserting all components except the transistors, and the wire link on the top of the board as shown in Fig. 6. Turn the board over and connect up the two supply lines along the two sides of the board using 18 or 22 s.w.g. tinned copper wire. Next connect up the remaining components using the component leads where possible and connect the flying leads.

Finally insert the transistors checking carefully the lead connections with the underside view shown in Fig. 6, and solder them to the other components using a heat shunt on each lead as it is soldered. After checking the circuit board mount the board on the aluminium angle bracket and mount this on the front panel together with the remaining components.

Wire up all the components to the circuit board as shown in Fig. 7 and check the completed unit carefully before connecting the battery and switching on.

*Continued on page 386*



THIS month we have one item which many readers will probably wish to construct but which is not given in the form of a constructional project. It is the simple passive mixer that is described and drawn up in the *Making Electronic Sounds and Music* feature.

Since this is really a bonus that will be useful to those following the article we have not given full constructional details or a components list. All the component values are given on the circuit diagram and the wiring diagram shows how they are put together. The three sockets can be any type suitable for use with your particular tape recorder—the types we have shown are phono sockets.

The complete unit can be mounted in any small case. No battery or power supply is necessary. We would like to emphasise that this is a simple passive mixer and will not be able to cope with all inputs.

A more advanced type of mixer may form the subject of a future article. However this simple mixer should be suitable for use with the *Audio Tone Generator* that is also described in this issue.

### Audio Tone Generator

There should be very few buying problems for the *Audio Tone Generator*. As described above the sockets could be changed to any suitable type if your equipment does not use phono sockets or if you already

have other types. Once again the case for this project can be any type that is available in a suitable size.

### Bee Counter

We find it difficult to comment on the availability of cedar wood—not after-shave—but apparently this wood must be used or the bees will not accept it!

As far as the remaining components for the *Bee Counter* go make sure that the resistors you buy are of adequate wattage. The lamp and holder should be of the miniature type so that they can be accommodated in the wooden base panel. Since the current drawn by this circuit is fairly large the section in the article concerning the battery should be noted.

There are a number of Post Office type counters available so make sure you get the right one—4.2 ohms coil resistance is the important thing.

### Metal Locator

The *Metal Locator* is a project which we are sure will create great interest but please remember that this is a simple one-transistor design and cannot be expected to out-perform a £30 unit. The use of Perspex or Paxolin is recommended for the locator head as these materials are not affected by damp or water.

All remaining components for the locator should be readily available. The use of a subminiature switch is recommended since only a small hole then needs to be cut in the plastic beaker. Any 50 $\mu$ A moving coil meter could be used in the locator provided it will fit the beaker lid. The one specified is probably the cheapest.

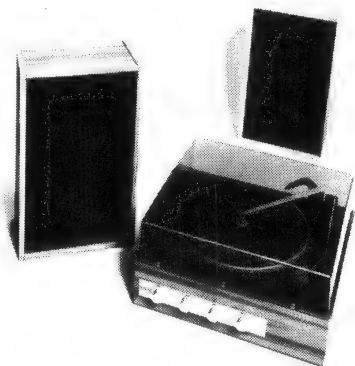
Finally do not forget the operating licence and don't say we did not tell you!

### New Products

Two products from one go-ahead firm have been introduced this month. Both in the audio field, possibly the most outstanding is the Unisound 505 as Radio and T.V. Components call their do-it-yourself £25 stereo system. This competitively priced unit comes as a complete kit and only needs two screwdrivers to put together. All the electronics are in module form and are supplied

with wiring looms that only need connecting up using a screwdriver supplied with the kit.

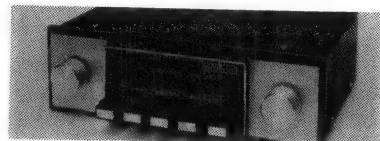
The large EMI speakers are housed in attractive cabinets again put together with only a screwdriver. It is said that anyone who can wire up a mains plug can put the system together in one evening. The system utilises modified Mullard Unilex modules, has an output of 3.7 watts continuous sine wave r.m.s. per channel; and frequency response of 40Hz to 20kHz at the 3dB down points. It would be very difficult to buy the individual components—including Garrard 2025TC deck, cartridge, plinth and cover and build a unit to match this one for £25, excluding the two speakers and cabinets.



The second unit from RT-VC is a £7 push button car radio kit, slightly more difficult to construct but any reader who has some experience of soldering should be able to build a working unit.

The kit is of good quality and uses the same push button tuning unit as radios costing three or four times the price. These features ensures good sensitivity and the pre-aligned i.f. (intermediate frequency) module and tuner avoid complicated alignment.

The kit is suitable for 12V positive or negative earth operation and readers may like to note that an after sales service—to repair any item not functioning correctly—is operated by RT-VC for all their kits; cost about £2 depending on the fault.





# Making Electronic Sounds and Music

BY FRED JUDD

## Simple experiments with a tape recorder

**T**HE term "electronic music" almost defies explanation because it is not the music that is electronic but the equipment and methods of creating it.

Its origin goes back many years, in fact to the invention of the thermionic valve and even as early as 1921 a "concert" of electronic music was performed in Paris by an Italian, Luigi Russolo, who used what was then called electrical sound generating and reproducing equipment.

Electronic music was difficult to perform directly from sound generators, etc., because composition required arranging the sounds in a given order and even changing the order, and sometimes the sounds, at a later time.

### MODERN METHODS

Magnetic tape recording finally provided the ideal medium for composition. The sounds required could be recorded and rearranged afterwards by simply cutting out the pieces of tape containing them and splicing these together again in the order required. This technique paved the way for composers who, with both electronics and magnetic tape at their disposal, could produce new kinds of music with tonal qualities never before possible.

More recently of course the music synthesizer has taken over the task of tone generation, etc., and electronic music composers can now programme a synthesizer, couple it to a tape recorder and produce "instant" electronic music.

Nevertheless there is much that can be accomplished by the amateur with an ordinary domestic tape recorder, an audio tone generator (like the one described on page 358) and some splicing tape. The techniques are simple and you can get a good deal of fun out of experimental electronic music and "science fiction" sounds.

Your efforts need not be wasted either because you can enter them for the experimental music and sounds section of the annual British Tape Recording Contest (details later).

### EQUIPMENT

An ordinary spool to spool tape recorder is the main requirement and if you have a stereo recorder with provision for recording independently on either track or you can get together with a friend and use two tape recorders, so much the better. A tape recorder with track-to-track or duoplay facility is also advantageous especially if it permits echo effects.



It is not possible to lay down procedures for specific makes and types of tape recorder but you will find that most of the techniques described can be applied.

Note that cassette or cartridge tape recorders are of limited use for creative recording of this nature which requires fairly extensive tape cutting and splicing.

Most modern spool to spool tape recorders are designed for stereo operation employing half or quarter track on standard quarter inch wide tape. If the tape recorder has a track-to-track recording facility it will have separate recording and replay heads, thus allowing a recording on one track to be copied on to another together with other signals.

Some stereo recorders may only have a common record/replay head which will not normally allow track-to-track copying but may have a facility for making separate recordings on each of two tracks. Information concerning such facilities should be given in the tape recorder instruction book. If in doubt, you should contact your dealer or the manufacturer for such information.

## AUDIO TONE GENERATOR

An audio tone generator is not absolutely essential but is most advantageous. The simple *Audio Tone Generator* described on page 358 is quite suitable as it covers a wide enough frequency range and will deliver a square-wave or a nearly sawtooth-wave output signal, thus providing two basic sounds.

Sounds picked up by a microphone can also be used because these can be reshaped by tape cutting and splicing and by certain recording techniques. Magnetic tape will be required of course and for initial experimental work low priced brands will suffice.

Some splicing tape and blank leader tape will also be required. Do not use ordinary plastic sticky tape, such as Sellotape, for splicing as

this may damage the tape and will not give a long lasting joint. Small kits of coloured leader and proper splicing tape are readily available. A small tape splicer is also a very useful, though not essential, tool.

## FIRST EXERCISES

It is important to know the extent to which your tape recorder can be used. If it has two or three speeds, as most of them do, record some musical sounds, whistling will do, at all three speeds and then play them back at one speed only, say the highest.

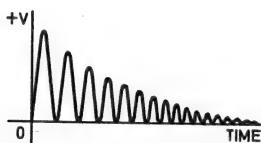
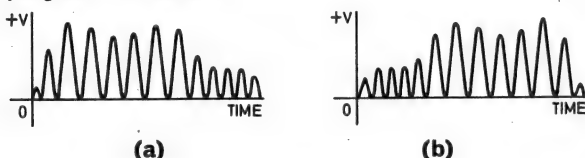
The sounds recorded at the lower speed(s) will be raised in pitch, by one or two octaves, depending on the speed. If the replay speed is double that of the recording speed the pitch is raised one octave and the sounds will occur faster but if the replay speed is half the recording speed, the pitch will be reduced by one octave and the sounds will occur slower. This is one of the most simple but most used techniques.

## REVERSE REPLAY

Now, if your recorder is a stereo machine try turning the tape over (reverse the spools) and see if you can obtain replay on another track in reverse, i.e., the sounds will be going backwards. This technique is also commonly used for electronic music because it alters the nature of the sound completely by placing what was the beginning of the sound, i.e., its attack, at the end as illustrated in Fig. 1 in which (a) is the sound as recorded and (b) as played in reverse.

If you cannot play sounds in reverse try this exercise; connect a tone generator, or if this is not available record whistles through a micro-

**Fig. 1. (a) Original waveform of the recorded sound (b) The sound recorded and shown in (a) played in reverse.**



**Fig. 2. Waveform of a sound which starts instantly and slowly dies away.**

**Photograph showing the use of a tape splicer to join up a number of sounds.**





**Recording various sounds, using the microphone, to form a composition.**

phone. Start with the recording level control at the maximum, set the tape running to record the sound but then almost simultaneously slowly turn the record level control to zero.

On replay you will have a sound that starts instantly and then slowly dies away as in Fig. 2. With a little practice you will be able to get various dying away or decay times depending on the speed at which the recording level control is turned off. Now try the reverse procedure; gradually increase the sound whilst recording and then quickly stop it.

## **TAPE CUTTING EXERCISES**

Now try some tape cutting; first use the highest tape speed and record a few sounds of different pitch, i.e., from a tone generator, or whistles via the microphone, each one lasting two or three seconds.

Locate the beginning of each sound on the tape by carefully feeding the tape across the head and then cut the tape about two inches in front of the sound. Run off the remainder until you reach the beginning of the next sound; cut the tape here and splice to the end of the piece containing the first sound. Cut and join pieces of the remainder of the sounds.

On replay you will have a series of short sounds each rapidly following the other. Now try a similar exercise but this time insert pieces of blank leader tape between each sound.

## **MUSIQUE CONCRÈTE**

Finally a variation of the two previous exercises. Record a few sounds each at a different tape speed. These should preferably be musical sounds, such as whistles or tones, or sounds produced by tapping a wine glass for example. Cut one or two pieces of each from the tape and assemble them at random with pieces of blank leader between groups. The pieces may be long or short.

Try replaying the assembled tape at different speeds and note the effect. You are well on the way to a form of composition known as "musique concrète" which is the creation of abstract forms of music out of real sounds. The same technique can, however, be used for abstract forms of electronic music in which the main sound source is an audio tone generator.

## **USING A TONE GENERATOR**

The exercises outlined above demonstrate how almost any recorded sound can be altered by tape cutting and by recording and replay at different tape speeds. Electronic music does not normally include natural sounds recorded via a microphone and therefore the sound sources are electronic, i.e., from tone generators of one kind or another. The recording and tape cutting techniques, however, remain the same.

If you have a full range audio signal generator then tones can be recorded at the pitch required. The simple generator described on page 358 has a frequency range of approximately 50 to 2000Hz.

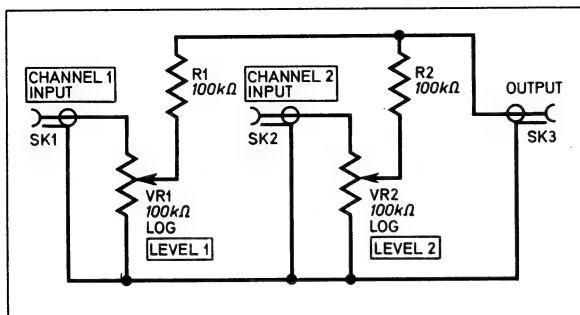
If frequencies outside the range of the generator are required it is simply a case of recording and replaying at different tape speeds for example; if a frequency of around 4000Hz is required, record the highest pitch of the generator (approximately 2000Hz) at a tape speed of  $3\frac{3}{4}$ in/sec (inches per second) and replay at  $7\frac{1}{2}$ in/sec.

If a very low pulsing sound is required at say 20 to 25Hz record a square-wave signal from the generator at its lowest pitch and then replay the recording at half the speed. Some experiment in this direction will soon reveal the tonal and pitch ranges that can be obtained simply by recording and replaying at various tape speeds.

Once this has been done, further experiment with the audio tone generator can be carried out in order to discover the type of sounds that can be produced. Start by recording a continuous note and while recording this vary the frequency and output controls on the generator, try this for both the square and sawtooth outputs (note that the output in the sawtooth position is much lower than in the square wave position).

Try cutting and reversing the sounds recorded to obtain various effects. You can also try making recordings at a distorted level by turning up the record level control, this will distort the original sound and produce yet another effect. Try switching from one output waveform to the other whilst recording—you can vary frequency and output at the same time—and also try switching the generator on and off while recording, again you can vary the output and frequency whilst turning on and off.

Edit the sounds produced by cutting and splicing and experiment fully with all possible



**Fig. 3. Circuit diagram of a passive mixer that can be used for making electronic music.**

effects. Once you have done this and feel fully conversant with the various effects that the generator is able to produce you can start to add one effect to another.

## SIGNAL MIXING

Recording from track-to-track or using two separate tape recorders may necessitate mixing signals that are to be recorded and re-recorded i.e., signals from a recording already made to be mixed with signals from another source such as the tone generator.

Some recorders have built-in mixing facilities whilst others may permit a form of mixing by using the track-to-track recording facility or by superimposing one sound on another previously recorded. Again the tape recorder instruction book will provide information of this nature.

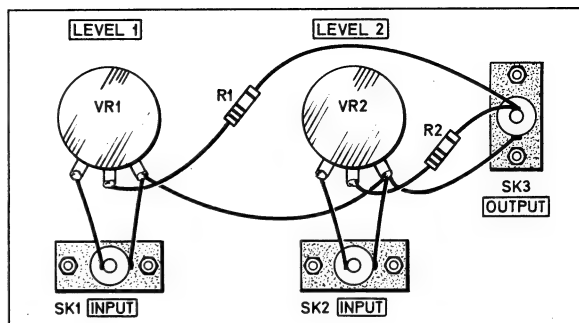
However, it is possible to build a very simple mixing circuit as shown in Fig. 3; Fig. 4 shows the construction. This is known as a passive mixing network, but will allow two signal sources to be mixed at different levels and coupled to a common input on a tape recorder (Fig. 5).

## TAPE LOOPS

Another interesting technique widely used for electronic music is the tape loop. This is the use of a small endless loop of tape containing recordings which are played continuously to produce repeating rhythm patterns.

Record a few natural sounds, or low pitched tones from an audio generator, of quite short duration, one immediately after the other. Cut a piece of the tape containing the sounds, about 18 inches long, and splice the ends together so as to form a complete loop. Place the loop in the recorder so that it runs past the tape heads when the machine is set to replay. You can hold the loop under tension by one of the methods shown in the photographs. Try running the loop at different speeds and, if possible, reverse the direction.

Record some percussion sounds, e.g., sounds produced by knocking together empty boxes, etc. Cut out pieces and make up a loop consisting of the various sounds and blank leader tape.



**Fig. 4. Constructional details of the circuit shown in Fig. 3. Shop Talk refers to this figure.**

For the first attempt use only two or three sounds and two or three pieces of leader.

You can make up an almost endless variety of fascinating rhythm patterns by this method and if you use two tape recorders the rhythm loop can be copied from one to the other whilst other sounds are added.

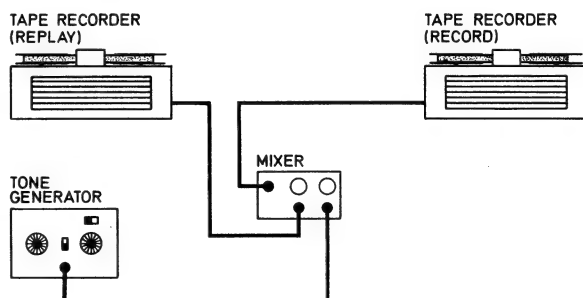
## MULTIPLE RECORDING

If you have a tape recorder with a track-to-track recording facility the scope is much wider as sounds may be recorded on one track and then re-recorded on to another track whilst adding more sounds. If your tape recorder can produce the echo effect this too can be used in various ways to produce those echoing science fiction sounds. Try allowing the echo to build up into a crashing roar and see if you can play it in reverse.

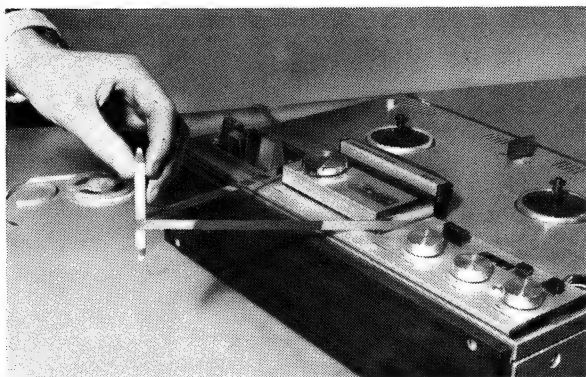
Now that you have discovered the variety of sounds and rhythms available using the facilities you have it is up to you to put these together to form an interesting "musical" passage. It may take some time before you achieve the required effect.

By combining even a few of the techniques outlined the number of permutations possible are fantastic. Instructions on composition cannot be given because no rules exist. Your ideas must come solely from imagination and experiment.

**Fig. 5. Using the passive mixer to combine two signals for recording purposes.**







The three photographs on the left illustrate various methods of using a tape loop. The top photograph shows a reversed loop held under tension by passing it around a pencil; this is only suitable for short periods.

The centre photograph shows a reversed loop held under tension by a small spool hanging over a table edge; this is only suitable for fairly large loops.

The lower photograph shows a system that can be used for any size loops by routing the tape around suitable objects—batteries are shown. This photograph also shows a cardboard tape holder used to keep recorded sections of tape in the order required.



## COMPETITION

Finally, why not try an entry for the "technical experiment class" of the annual British Tape Recording Contest. It is open to anyone and the closing date for the 1972 contest is not until June 30. The Technical Experiment class allows for tapes of up to 4 minutes duration and includes; sound composition, electronic music, musique concrète, multi-track music and experimental sound recordings. The prizes are worthwhile and you can get an entry form free by writing to The Secretary, British Amateur Tape Recording Contest, 33 Fairlawnes, Maldon Road, Wallington, Surrey, and enclosing a stamped addressed envelope. You may also be interested to know that the special "Tape of the Year" award for 1971 was for an experimental class entry.

Every tape entered is carefully assessed by the expert judges and their comments are passed to the contestant concerned when the tape is returned. Thus you will know how to make an even better tape next time. □

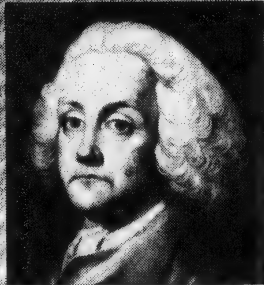


## PLEASE TAKE NOTE

The approximate cost of components given in the Simple Calculator article last month was incorrectly shown as £1.20. This should have been £2.20.

The probe flying lead in the Signal Injector article (March issue) should be soldered to Y3 not Y2 as stated in the text.

The Normatest 2,000 multi-range test meter mentioned in Shop Talk last month is available from: Croydon Precision Instrument Company, Hampton Road, Croydon, CR9 2RU.



# THEY MADE THEIR MARK

**No 1 Introduction By J. E. Gregory**

**E**LECTRONICS is an internationally uniform world of symbols. Look at any advertisement or study the simplest circuit diagram in *EVERYDAY ELECTRONICS* and you will be confronted with strange symbols of every shape. Magical signs used to signify basic units of physical quantity; Table 1 lists some of them.

Although electronics is regarded as a modern science and hobby many of these units are named after pioneers, scattered throughout the world, whose accumulated research spans hundreds of years.

This series sets out to explain the symbol, and perhaps more important something of the man who gave his name to it. But let's begin our potted history of electronics at the beginning.

## THE GREEKS HAD A WORD FOR IT

Take the word electronics itself, for that we must go back in time to ancient Greece. To the ladies of Greece passing time by decorating their spinning wheels with amber, found on shores in the far north. They observed that the amber when contacting the threads would draw the threads to itself as they separated from the wool, and then push them away in a frictional force. The

Greek word for amber was *elektron*, from the verb *elkein* to attract. Although this phenomenon was observed and noted by several of the great Greek philosophers we have to jump two thousand years to the early 1600's and to the reign of Good Queen Bess, who was persuaded by her physician William Gilbert, to attend a demonstration of a frictional electric machine based upon the power of amber to attract. This power he called *electricity*.

It was soon realised that the crackling and sparking of Gilbert's electric machine were the same phenomena on a minute scale, as thunder and lightning, but how to prove it?

## THE KITE FLYER

One of the first to try was the fifteenth child of an English immigrant; born in Boston Massachusetts in the year 1706, this was the well known American statesman and philosopher Benjamin Franklin (see illustration above).

His historic but dangerous

experiment trying to capture electricity from the sky occurred during a thunderstorm in the summer of 1752, when accompanied by his small son, he flew a kite with an iron door key. During the storm, he saw that sparks sprang from the key to his wrist, what he didn't realise of course was that if the lightning had actually struck the kite he would have been killed.

The study of natural phenomena had to take second place to his other activities, but he came to the conclusion that thunderstorms were simply the levelling of opposed electrical potentials, between one cloud and another or between a cloud and earth.

It was Franklin who introduced the positive and negative signs for electric charges, realising there are two kinds which neutralise each other.

Next month we move from America to 18th Century Italy and a scientist, Alessandro Volta, after whom the Volt, the measurement of electrical potential is named.

*Photograph: Science Museum, London.*

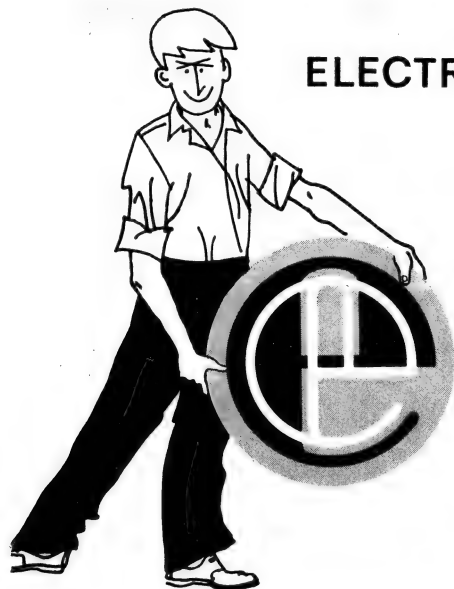
**Table 1 FUNDAMENTAL UNITS**

unit symbol	name of unit	physical quantity
A	Ampere	Electric Current
V	Volt	Electric Potential
F	Farad	Electric Capacitance
$\Omega$	Ohm	Electric Resistance
W	Watt	Power
Hz	Hertz	Frequency
H	Henry	Inductance

These basic units are often inconveniently large or small and the units are prefixed with the following symbols:

p	pico	$\div$ 1,000,000 million
n	nano	$\div$ 1,000 million
$\mu$	micro	$\div$ 1 million
m	milli	$\div$ 1,000
k	kilo	$\times$ 1,000
M	mega	$\times$ 1 million
G	giga	$\times$ 1,000 million

Hence 5kV = 5,000 Volts ; or 5mV = 0.005 Volt



# ELECTRONIC CIRCUITS - ..... IN THEORY and PRACTICE

# TEACH-IN ... FOR BEGINNERS

By Mike Hughes M.A.

## 7 SEMICONDUCTORS: Transistors

**T**HIS year sees the twentieth birthday of the component most responsible for bringing electronics within the scope of do-it-yourself enthusiasts; it has greatly simplified design and construction and has also brought about terrific reductions in costs. It is the "transistor".

As a replacement for the valve, it allows us to use low voltages and removes the arduous task of having to assemble valve bases and massive transformers on tank like chassis. Connections to a transistor are few and the basic way it operates in a circuit is quite easy to understand.

### PNP—NPN

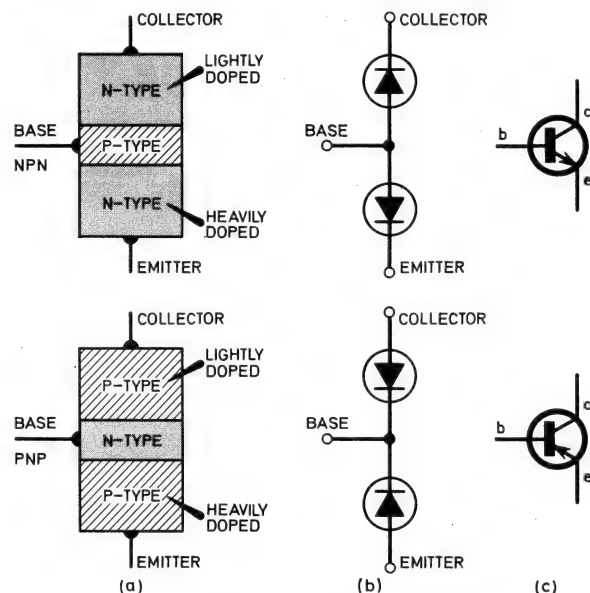
The transistor is a member of the semiconductor family and is basically a sandwich of different types of either silicon or germanium. The "filling" of the sandwich can either be *p*- or *n*-type material; we can clad a *p*-type filling with *n*-type material giving what we call an *npn* transistor. Alternatively a *pn*p device is made by filling a *p*-type material with an *n*-type.

One encounters both types in practice but nowadays *npn* devices made from silicon predominate, the reason being that they are easier to make and hence cheaper!

Fig. 1(a) shows a diagrammatic cross-section of both types of transistor, *pn*p and *n*p*n*. One end is heavily doped and is called the "emitter"; the other end is lightly doped and called the "collector".

The filling material is very thin in practice (usually one or two microns; 1 micron is a

millionth of a metre) and is called the "base". In its simplest form you can think of an *n*p*n* device as two diodes connected together by their anodes (back-to-back), and facing each other in a *pn*p device, Fig. 1(b).



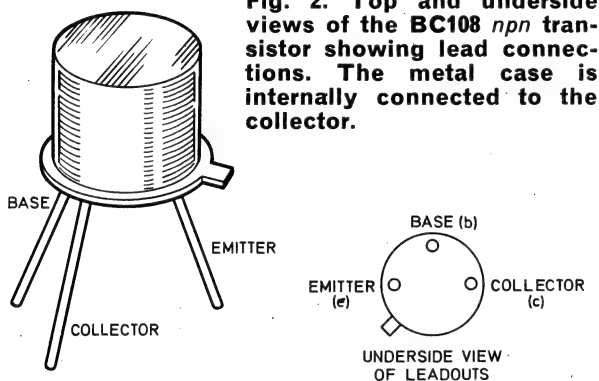
**Fig. 1. (a) Schematic diagram of the internal make-up (b) equivalent representation and (c) circuit symbol for (top) *n*p*n* transistor and (bottom) *pn*p transistor.**



## BASE CONNECTIONS

All the transistors you will come across have connections brought out from the emitter, base and collector. A very common silicon *npn* device is the BC108 and we shall be referring to this frequently in this series.

Fig. 2 shows what it looks like. If you have one handy see if you can identify which lead is which.



**Fig. 2. Top and underside views of the BC108 *npn* transistor showing lead connections. The metal case is internally connected to the collector.**

The emitter is the one closest to the spigot on the side of the can, the collector is diametrically opposite, and the base is between the two but set off to one side. This is a metal can transistor and the can is electrically "live"—in actual fact it is connected to the collector as well as the lead out wire.

Different types of transistor may have different shaped cans and some are in plastic encapsulations. Always make sure you know which lead is which before you start using a transistor.

Most constructional projects in *EVERYDAY ELECTRONICS* give you lead designations for the transistors specified, but if you want to experiment with alternative types make sure you know the correct base lead connections.

## SIMPLE TEST

Use the BC108 *npn* transistor to identify the effect of the two diodes connected back-to-back. First of all make an ohmmeter on the Demo Deck. Use a 4.5V battery (not 9V) in series with a 2.2 kilohm resistor and VR2 (5 kilohm). Complete the circuit and set VR2 to give zero ohms at full scale deflection and then connect the leads of your ohmmeter between the base and emitter connections of the transistor—to do this it is best to solder the transistor on to three adjacent pins of the Demo Deck and use crocodile clips on the leads from the meter.

If you connect the meter so that the lead coming directly from the negative terminal of the battery goes to the emitter, the meter needle will move to almost full scale showing there is little resistance in the transistor. Now reverse the leads so that the base is more negative than the emitter—you should see that no current

flows (indicated by meter needle not moving). Thus the base-emitter junction is a diode and follows the same rule that we saw last month.

Now leave the lead on the base and transfer the one from the emitter to the collector—again no current flows but reverse the leads and current flows between the base and collector.

If you connect the leads between the collector and the emitter no current should flow whichever way you have them because in both connections, the current would have to pass through a reverse biased diode.

This simple experiment can be used as a rough and ready test to check if a transistor is likely to be in working order, and provided you remember the rule "make p stand for positive for current to flow" you can use it to identify *npn* and *pnp* transistors.

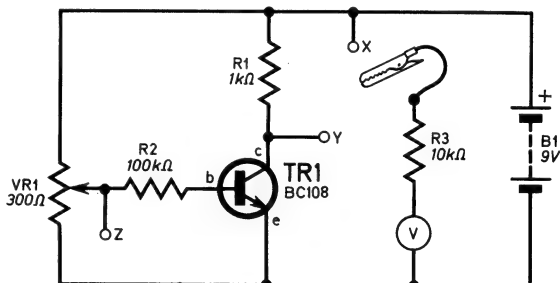
## REVERSE VOLTAGE LIMITS

Like all diodes, the junctions of a transistor have reverse voltage limits. These are usually specified with abbreviations. For the BC108 the reverse emitter-base voltage ( $V_{ebo}$ ) is 5V—i.e. you must never make the base more than 5 volts negative with respect to the emitter (this is why we had to use 4.5V for our ohmmeter instead of the 9V we have been used to). Likewise the reverse base/collector voltage ( $V_{cbo}$ ) is 30V. You might expect the reverse voltage between the emitter and the collector to be equal to the highest of the other two but this is not the case—it is lower—for the BC108  $V_{ceo}$  is 20V.

The "O" in the suffixes of the reverse voltage characteristics indicates that the third terminal is "open circuit" i.e. not connected.

## HOW THE TRANSISTOR WORKS

Let's see what a transistor actually does by using the circuit of Fig. 3(a). Now that we are using the transistor in a real circuit it is important to note the polarity of the supply voltage—for an *npn* transistor the collector must **always** be kept more positive than the emitter (the converse applies to *pnp* devices). We are going to make the transistor work like a tap and control the amount of current flowing through R1. You can see this happening if you follow the details through on the Demo Deck.



VR1 is a 300 ohm potentiometer working as a potential divider giving us a variable supply at its wiper.

Wire up the circuit of Fig. 3(a) on the Demo Deck as shown in Fig. 3(b), but do not connect R2 to the base of the transistor just yet.

Resistor R3 and the 1mA meter makes a 10V range voltmeter in the usual way. Connect the negative lead to the emitter of the transistor. All voltages we measure will be relative to that of the emitter.

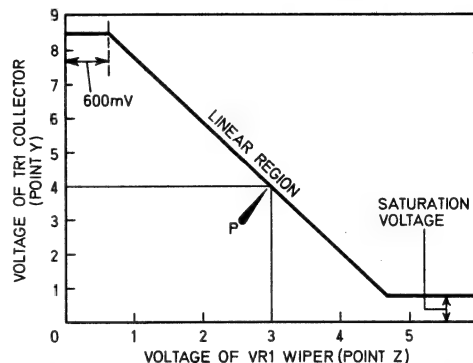
First measure the power rail at point X—it should, of course, be +9V; now measure the potential at the collector of the transistor (point Y) it should be +8.2V. This is what is expected because no current can flow through the back-to-back diodes of the transistor, but the meter will draw some! If you had a high sensitivity meter (say 20 kilohm per volt) this current would be negligible and you would see +9V at both points, X and Y.

Now set VR1 so that the potential on its wiper is zero (with respect to the emitter) and connect R2 to the base of the transistor. VR1 potential is measured by attaching the crocodile clip from the meter to point Z. Again measure the potential at the collector—it should not have changed.

We shall now see what happens if we increase the potential at the wiper of VR1. Do this in 0.5V increments (use crocodile clip at point Z) and for each setting measure the collector potential. You should see that once the potential of the wiper exceeds 600mV, the potential at the collector falls, and continues to fall towards zero as the controlling voltage is increased. Once the collector potential reaches almost zero no more

control can be effected. We say that the transistor is now fully conducting between collector and emitter. This state is called “saturation.”

Record your results and plot a graph of collector voltage versus voltage at the wiper. A graph should be obtained similar to that of Fig. 4.



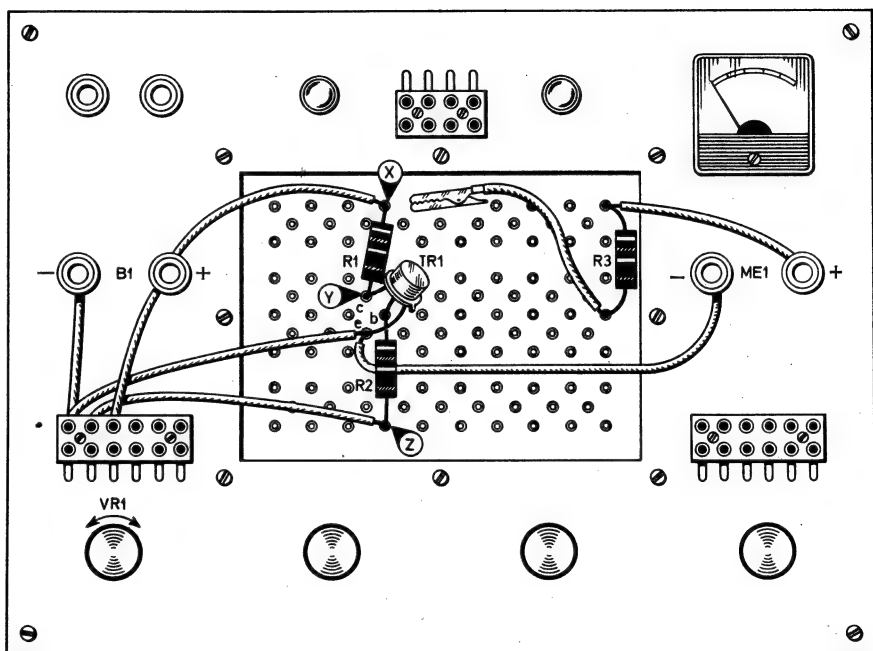
**Fig. 4. The graph obtained by plotting the recorded results of experiment using circuit of Fig. 3(a), i.e. voltage at point Y versus voltage at point Z.**

Control of the collector/emitter current is brought about by passing a current through the forward biased base/emitter junction. The more current we pass into the base in this way, the more current we can control between the collector and the emitter. The controlling current is called “base current,” ( $I_b$ ) and the controlled current “collector current,” ( $I_c$ ).

Base current is set by the potential difference between the wiper of VR1 and the emitter of the transistor, acting through the resistance R2

**Fig. 3(a) (left). The circuit diagram used for investigating some of the properties of a BC108 transistor.**

**Fig. 3(b) right. The circuit of Fig. 3(a) wired up on the Demo Deck.**



and any internal resistance between base and emitter. The latter is small and can be neglected at this stage. We must, remember, however, that the base must be made at least 600mV positive with respect to the emitter before any current can flow (this is the usual forward voltage drop for any silicon junction).

We can thus calculate the current flowing into the base by measuring the potential at the wiper of VR1, subtracting the base emitter forward voltage drop (600mV) and dividing by the value of R2.

## GAIN

If you do this for your experiment you will find that the base current ranges from 0 to 0.084mA. The range of collector current we are controlling was from 0 to 9mA. It can be seen that the transistor enables us to use a very small current to control a larger one. We call this effect "current amplification." The factor that governs the ratio between  $I_b$  and  $I_c$  is called "gain" and although it increases with  $I_c$  it is pretty well constant for any given transistor. It can, however, vary widely between different types of transistor and even between devices having the same type number! Provided you take a combination of base and collector currents within the controllable region (this is called "linear region") you can calculate the gain of the transistor you are using.

It would be best to increase the potential at VR1 until the collector potential is approximately 4V. This reduces the shunting effect of our voltmeter.

Use the precise values of voltage measured to calculate the current through R2 and R1 then use the ratio of these values to calculate the gain.

$$\text{gain} = \text{collector current} \div \text{base current} \\ = I_c \div I_b$$

For the BC108 transistor it should be approximately 200, but as we have said, will vary from device to device.

**Example** To calculate the gain from your plotted curve (similar to the one of Fig. 4) select a convenient point on the linear region such as point P of Fig. 4.

The base current,  $I_b$  is given by the voltage difference between the base and emitter divided by the base resistor.

$$\text{i.e. } \frac{3 - 0.6}{100.000} = 0.024\text{mA}$$

Now the voltage drop across the collector resistor R1 is  $(9 - 4)\text{V} = 5\text{V}$ . Therefore, collector current  $I_c$  is  $(5 \div 1000) = 5\text{mA}$ .

Substituting these values for  $I_c$  and  $I_b$  in equation (1) gives the gain  $= (5 \div 0.024) = 208$ .

There are various ways of describing current gain for a transistor so we shall define that measured above a little more precisely—it was the d.c. current gain. This is sometimes abbre-

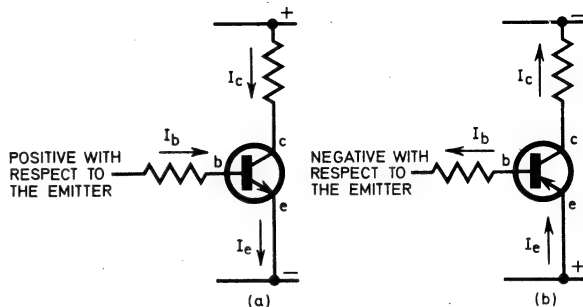
viated to the designations  $\beta$  (beta) or  $h_{FE}$ . The latter is rather a strange type of designation but is one of a range of what are called "h" parameters—we need not worry ourselves about these in this series except for the term  $h_{FE}$  which is usually used in manufacturer's data sheets. Do not confuse  $h_{FE}$  with  $h_{fe}$ , the latter is called the small signal current gain and we shall not be dealing with this until later.

The gain equation above can be rewritten:  
 $I_c = h_{FE} \times I_b$

Remember that the experiment we have just done has been using a silicon npn device. We could have used one made from germanium having npn structure and obtained a similar effect—except that the base/emitter forward voltage drop would have been only about 200mV and  $h_{FE}$ , in general, would have been lower.

We could also have used a silicon or germanium pnp device but would have had to reverse the battery connections so that the collector was negative with respect to the emitter. The same rules would have applied and we could have still calculated a value for  $h_{FE}$ .

If you are a little confused by the difference between npn and pnp devices do not worry too much as this stage—most of the early experiments in Teach-In will use npn devices and when you have got used to these you will find it quite straightforward to switch over to pnp devices when necessary. The most important thing to remember is the polarity of battery voltage when using one type or the other. An aid to remembering what the polarity ought to be is to bear in mind the direction of conventional current flow;



**Fig. 5. Circuits showing major current flow directions for (a) npn and (b) pnp transistor.  $I_b$ —base current,  $I_c$ —collector current,  $I_e$ —emitter current.**

the arrow on the emitter of the symbol points in the direction of current flow, i.e. it points away from positive and towards negative. See Fig. 5.

Whether using npn or pnp devices an aid to remembering how to turn collector/emitter current "on", is to make the potential at the end of the resistor connected to the base tend towards the same polarity voltage as applied to the collector; the more you move towards this voltage, the more  $I_b$  increases, and  $I_c$  will increase in direct proportion.



When the potential feeding the base rises towards the supply voltage the voltage at the collector falls towards the emitter voltage. This is called "inversion."

In Fig. 3  $R_1$  is called the "collector load." The limit of  $I_c$  control is set by the value of this resistor; if it has a high value then it does not matter how much base current you apply, you cannot control more collector current than that given by the collector supply voltage divided by the value of collector load. On the other hand, if the load is too low you might find yourself trying to force more collector current than the construction of the transistor can handle. Thus one of the specifications of a transistor is the maximum collector current it can handle without "blowing". This is called  $I_{c\max}$  and for the BC108 is 100mA.

A final parameter we must deal with is the power rating of a transistor. As current is passing through it a certain amount of heat is dissipated. We already know that too much heat can spoil the properties of a semiconductor so it must be limited. The limit is set by the maximum power dissipation parameter,  $P_{c\max}$ . It is easy to calculate what the power dissipation is likely to be; it is the dissipation you would get if you replaced the transistor in the circuit with a resistor having the same ohmic value as the collector load.

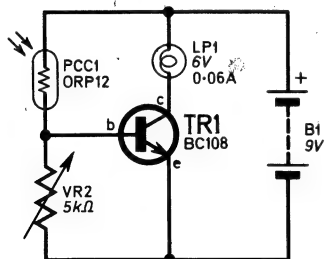
Table 1 gives you some typical values of parameters for some common transistors of varying types, powers and polarities.

**Table 1: THE MORE IMPORTANT CHARACTERISTICS OF SOME COMMON TRANSISTORS**

Type	Polarity	$P_{c\max}$	$V_{cbo}$	$V_{ceo}$	$V_{ebo}$	$I_{c\max}$	$h_{FE}$
BC108	npn	300mW	30V	20V	5V	100mA	240
2N2926	npn	200mW	18V	18V	5V	100mA	150
BFY51	npn	800mW	60V	60V	6V	1A	70
BFX13	pnp	300mW	-20V	-15V	-5V	100mA	120
2N3702	pnp	360mW	-40V	-25V	-5V	200mA	60
AC126	pnp	500mW	-32V	-32V	-10V	100mA	100
OC72	pnp	125mW	-16V	-16V	-3V	125mA	50
OC26	pnp	12W	-16V	-16V	-10V	3.5A	50
OC36	pnp	30W	-80V	-32V	-40V	10A	70

**Fig. 6(a) (below). The circuit diagram of the "Electronic Candle" which illustrates positive feedback.**

**Fig. 6(b) (right). The circuit of Fig. 6(a) wired up on the Demo Deck. Ensure that PCC1 is close to LP1.**



## ELECTRONIC CANDLE EXPERIMENT

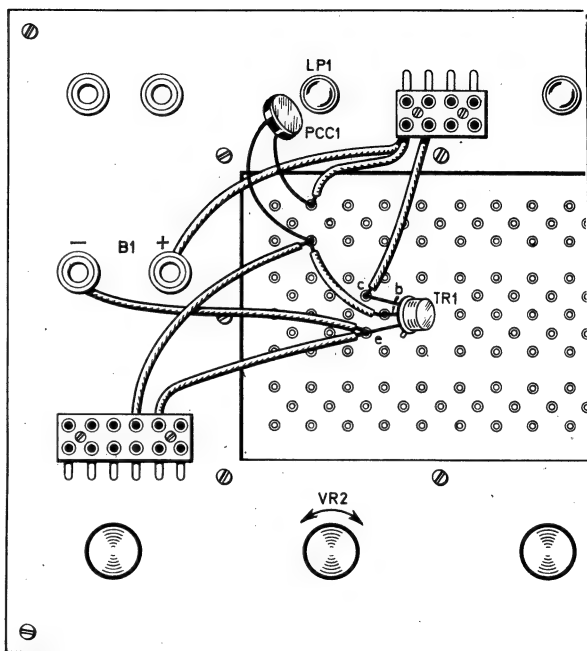
We shall now make a simple working circuit using the circuit diagram of Fig. 6(a). This is wired up on the Demo Deck as shown in Fig. 6(b). Connect the ORP12 (light dependent resistor) very close to the LP1 on the Demo Deck as shown below. Set VR2 to zero ohms. The potential at the base of TR1 will be zero, therefore no current will flow between collector and emitter. Now, in a reasonably lit room, increase the value of VR2. At a certain point the potential at the base will reach 0.6V (set by the potential dividing effect of PCC1 and VR2) and the transistor will start to conduct (the bulb will glow dimly).

Continue to increase the resistance of VR2; the current flowing through PCC1 will now pass into the base/emitter circuit of the transistor in preference to the higher resistance path through VR2. This base current will cause TR1 to pass more collector current until the bulb is fully illuminated.

When you reach this point (the minimum value of VR2 that will give full illumination) try casting a shadow over PCC1, the lamp will go dim and ultimately go out altogether as  $I_b$  reduces due to the resistance of PCC1. We did a similar sort of thing in Teach-In Part 4.

The difference is that we now have a circuit that is much more sensitive to small changes in light level which is brought about by the transistor amplifying the current from the photo resistive cell.

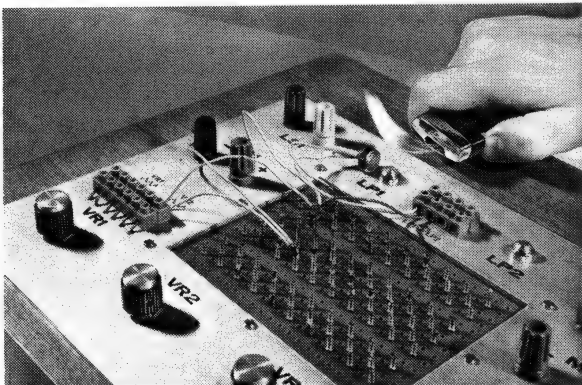
If you place the cell very close to the bulb in a dimly lit room you can set the value of VR2 so that the ambient lighting does not turn the transistor on, but the light from the bulb will.



Break the light path between the bulb and the cell and the bulb goes out and stays out. Now use a match or lighter to provide a stimulus of light. Bring it close to the bulb/cell assembly and the bulb lights up; you can now remove the match and the bulb will stay on because its own light output is holding the transistor on. This is called "positive feedback" and in this circuit will provide an amusing party trick—especially if assembled to look like a candle.

A bit of practice at "snuffing" the candle with the fingers (actually you are breaking the light path between the bulb and the cell) will make the effect even more astounding.

**Photograph of the Demo Deck set up for the Electronic Candle Experiment showing the lamp being "lit" by the light emitted from the lighter.**



## TEACH-IN PART 6—ERRATA

Fig. 4(b) last month shows a lead connected wrongly. The lead from the junction of R3 and the negative meter terminal should go to the negative end of VR1 (not the wiper as shown) i.e. the one connected to the battery negative.



**Next month: Multivibrators.** The components needed for next month in addition to those already acquired are: resistors 22 kilohm (2 off), 100 ohm (1 off); capacitors 0.1 $\mu$ F polyester (2 off), 500 $\mu$ F elect. 12V (1 off); transistors BC108 (1 off); diodes OA91 (1 off).

## Ruminations By Sensor

### Not so Clever

The coal miners' strike has shown how dependent we are, in this age of high technology, on the efforts of men who work in damp, dirty and often dangerous conditions.

I find it difficult to comprehend that on one hand the semiconductor industry owes its existence to the ability to obtain and to process materials with an impurity content of less than ten parts in a thousand million, and to operate with tolerances down to one millionth of a metre, while on the other hand men have still to dig fossil trees out of the earth (albeit with mechanical assistance) so that these fossilised remains can be burnt to boil water in order to raise steam

and to generate electricity! Without coal and electricity there would be no semiconductor industry; truly our idol has feet of clay!

### Let There be Light

Have you heard about the old lady who telephoned the C.E.G.B. to complain that, during the power cut, the buses were passing her house with all their lights on? She also said that she could manage to get along quite well without the electricity, except for the little light in the hall, and could they please leave that one switched on.

Many people must have been irritated, in the early days of the strike, to see street lights blazing all day and switched off at night, due to their electric clock switch mechanisms getting umpteen hours behind. To the electronics man the answer to this problem is so simple—a light operated switch, either using discrete components or in integrated form.

A recently introduced inte-

grated circuit provides the necessary photo cell, level sensor and time delay all on one tiny chip of silicon and complete with lens. It could operate a relay or, better still, work into a switching transistor controlling the street lamp directly.

Some years ago, I was shown around a large generating station, where, tucked away in a dusty corner there was a cast iron box about the size of a domestic cooker. This apparatus was installed at the station about twenty five years ago and its purpose was to switch on all the electric street lamps in the town.

When switched on it produced a ripple which was superimposed on the mains. Sections of street lighting were grouped together under the control of master switches, spread throughout the town, which were operated by switching on the ripple equipment. The system had been in use but for some reason, unknown to my guide, had been discontinued. It would have been a blessing during February 1972.

*Everyday Electronics, May 1972*

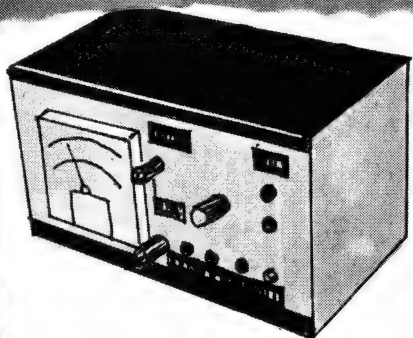
Watch for these features in the

**JUNE**



## Wash 'n Wipe

We have produced one very popular car wiper accessory now we are going to describe another. This unit starts the wipers automatically when the washers are used, keeps the wipers going for a pre-determined time, and then turns them off. For all 6 and 12V cars fitted with washers and self parking wipers. Extremely useful with the Windscreen Wiper Control or just on its own.



## Multimeter

Probably the most useful of all test equipment is a multimeter and next month we show you how to build a fairly simple one that will meet the needs of most constructors.

## Light to Sound Converter

A project for those who like to experiment. This unit produces an audio tone, the frequency of which is dependent on the light level sensed by a photocell.

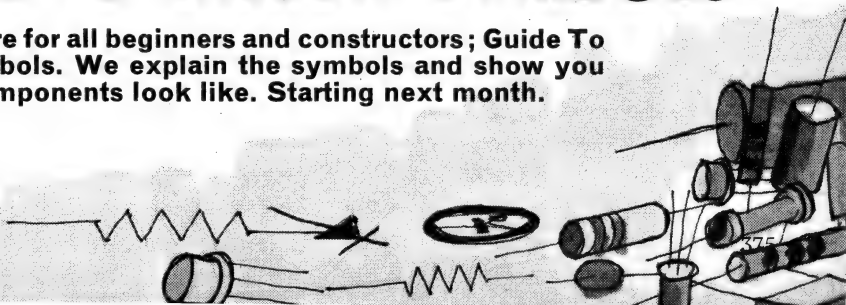
# Also...

## A new feature for all beginners and constructors... GUIDE TO CIRCUIT SYMBOLS

A new feature for all beginners and constructors; Guide To Circuit Symbols. We explain the symbols and show you what the components look like. Starting next month.

On sale Friday, May 19

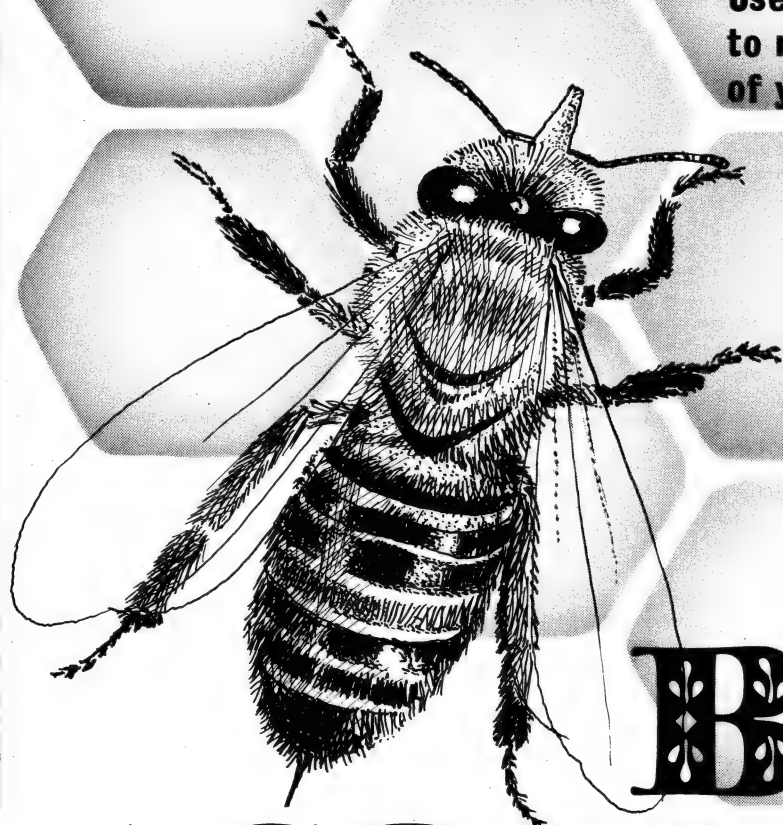
Everyday Electronics, May 1972





Use this 'electronic eye'  
to monitor the busyness  
of your bee-hives

By  
**G.A.Cozens**



# BEE COUNTER

**M**ODERN research calls for accurate measurement and comparisons, and with this in mind this device was designed to help the bee-keeper assess the performance of his beehives more definitely, and to compare the different strains of bees under the same working conditions and so help to breed a strain which will produce the most honey under all the difficulties encountered in our changing climate without the rather nasty habit of the English bee, of attacking the bee-keeper as soon as he appears anywhere near the hive.



The Bee Counter is an instrument which records the number of bees entering the hive, and used in conjunction with other devices such as a wind speed indicator, a wind direction indicator, an air temperature thermometer, a maximum/minimum thermometer, a rain gauge and a sunshine recorder, then some degree of assessment can be made, and some basis established for the bee-breeder to work upon his main goal—lots of honey from a reasonably good tempered, busier bee.

The Bee Counter makes use of the fact that bees are highly organised in their habits, and utilises the bees sense of sight and smell. These bee "characteristics" are used in the design of the cabinet housing all the circuitry which is described later in full detail.

## THE CIRCUIT

The complete circuit diagram of the counter is shown in Fig. 1 and is basically an amplifier which works as follows.

The lamp LPI, which is always "alight" when

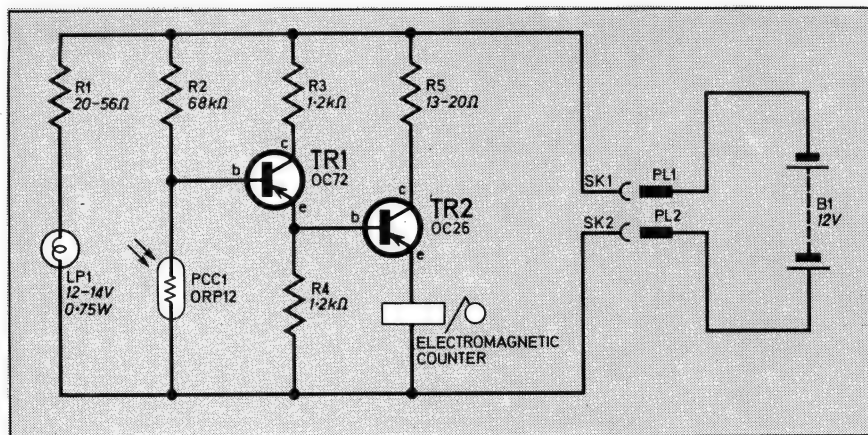


Fig. 1. The complete circuit diagram of the Bee Counter.

the unit is switched on, illuminates the light dependent resistor, PCC1, and causes its resistance to be at a low value, about 100 ohms.

The l.d.r. and R2 form a potential divider circuit and under "illuminated conditions" of the l.d.r., a positive voltage with respect to the emitter, is applied to the base of TR1 causing it to be in a conducting state.

With TR1 conducting, a negative voltage is applied to TR2 base with respect to the emitter and consequently TR2 is "off" (not conducting).

When the light path between LP1 and PCC1 is broken, the resistance of PCC1 increases considerably (to about 100 kilohm for complete "blackout"). This causes the potential at TR1 base to go negative and turns it "off". This state of TR1 causes the voltage applied to the base of TR2 to go more positive and causes it to switch "on" i.e. conduct—current flows through TR2.

When current flows through the emitter leg of TR2 containing the relay coil in the counter, the relay is energised.

When the light to PCC1 is restored, TR2 switches "off" and the counter is de-energised and springs back to its off position and in doing so mechanically adds "one" to the counter readout.

The arrangement of LP1 and PCC1 in the case is so devised that the bee, on entering the hive, breaks the light path between these devices and its entry is thus recorded.

The 13-20 ohm 3 watt resistor, R5, in the collector circuit of the power transistor, TR2, is to prevent damage to the counter or the transistor if the entrance passage to the hive should become blocked, as once happened in the prototype when a drone got stuck in the narrow part.

A heavy duty battery is required to operate the Bee Counter since current drain is substantial—250 mA when TR2 is "off" and 400 mA when TR2 is "on" at 12V. A car battery is therefore recommended to supply the power. The cost of this battery is not included in approximate cost.

The voltage is fairly critical as it must be sufficient to operate the counter, but not high

## Components....

### Resistors

- R1 20-56Ω 3 watt
- R2 68kΩ
- R3 1.2kΩ
- R4 1.2kΩ
- R5 13-20Ω 3 watt

All  $\frac{1}{2}$  watt carbon  $\pm 10\%$  unless otherwise stated

### Transistors

- TR1 OC72 (or similar) germanium *pnp*
- TR2 OC26 germanium *pnp*

### Light Dependent Resistor

- PCC1 ORP12

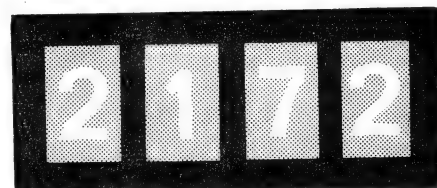
### Miscellaneous

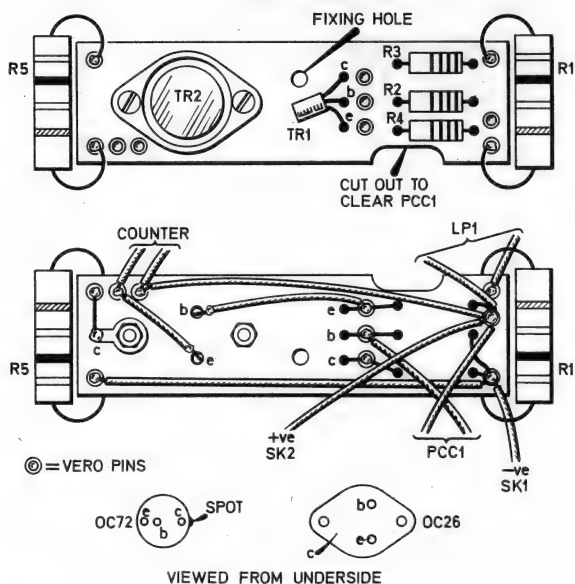
- LP1 12-14V 0.75W bulb and holder
- PL1, PL2 Wanders plugs, 1 red 1 black (2 off)
- SK1, SK2 Sockets to suit plugs PL1, PL2
- B1 12V battery—heavy duty rechargeable type (Not accounted for in cost box.)
- Counter: Post Office type 14C 4.2Ω 4 figure readout. Cedar wood, Perspex and adhesive, Paxolin, wood screws, 4 B.A. nut and bolt, wood glue.

SEE  
**SHOP  
TALK**

enough to cause overheating of TR2 or the counter coil in the event of the passage being blocked for long.

If the apparatus is disconnected every night the battery will last at least a week on one charge.





**Fig. 2. The layout of the components on both sides of the Paxlin board. Veropins are used for attachment.**

Variations in performance can be dealt with in several ways. The lamp should be bright enough to turn off the amplifier, but not any brighter than necessary. This is best adjusted by altering the series resistor R1, which may be increased to as high as 56 ohms.

Also, the size of the l.d.r. can be varied, or a part of the l.d.r. painted over so that it has less area exposed, until the instrument is sufficiently sensitive, but positive in its action.

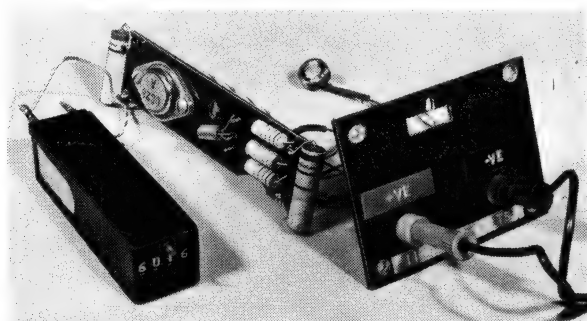
## THE COUNTER

The electromagnetic counter used is a Post Office type. It has a four digit readout and can thus count up to 9,999. The maximum count rate is ten per second.

## COMPONENT WIRING

Most of the components of Fig. 1 are mounted on a piece of Paxlin size  $4\frac{1}{2} \times 1\frac{1}{4}$  inches with a cut-out as shown along one side to accommodate the light dependent resistor, PCC1.

Both sides of the board containing the components are shown in Fig. 2.



Veropins are used for mounting the components in position and small holes should be drilled where indicated to accommodate these pins.

Three more small holes of the same size should be drilled to take the leads of TR1 as shown.

Drill the component board fixing hole and the four holes for transistor TR2; (see reverse side of component board Fig. 2);  $\frac{1}{8}$ in. diameter holes will do for all five holes.

Begin assembly by pushing in all the Veropins and then attach TR2 to the board using two small nuts and bolts.

The connection to the collector of TR2 is via its casing, so a solder tag should be attached to one of the securing bolts to enable this connection.

Attach and solder all the components, link wires and flying leads as detailed in Fig. 2 making sure a heat shunt is used when soldering in TR1, which incidentally should be the last component connected.

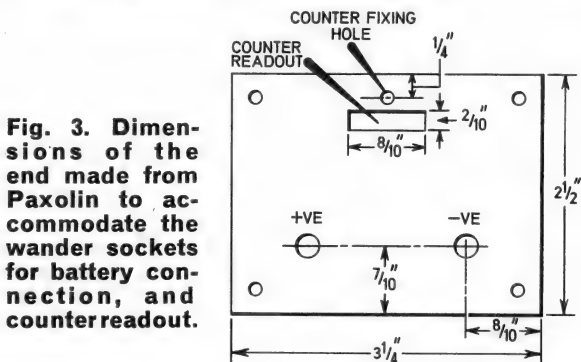
The l.d.r. should be attached to the board via 6in. long flexible leads.

The flying leads to the counter should be about 4in. long.

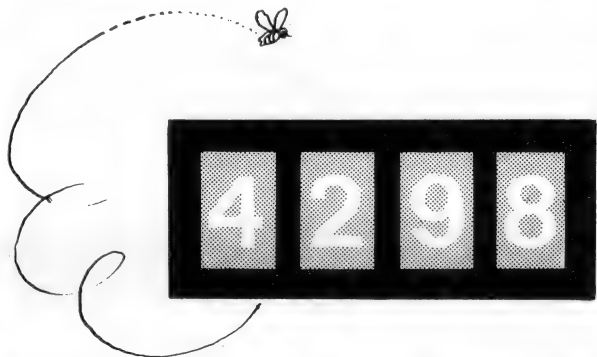
The two wander sockets used for battery connection to the counter, are attached to the end of the case which is made from a piece of Paxlin, dimensions are given in Fig. 3.

The connection wires from the wander sockets to the component board should be about 4in. long.

Connection to the battery is made via two wander plugs and a length of twin flex.

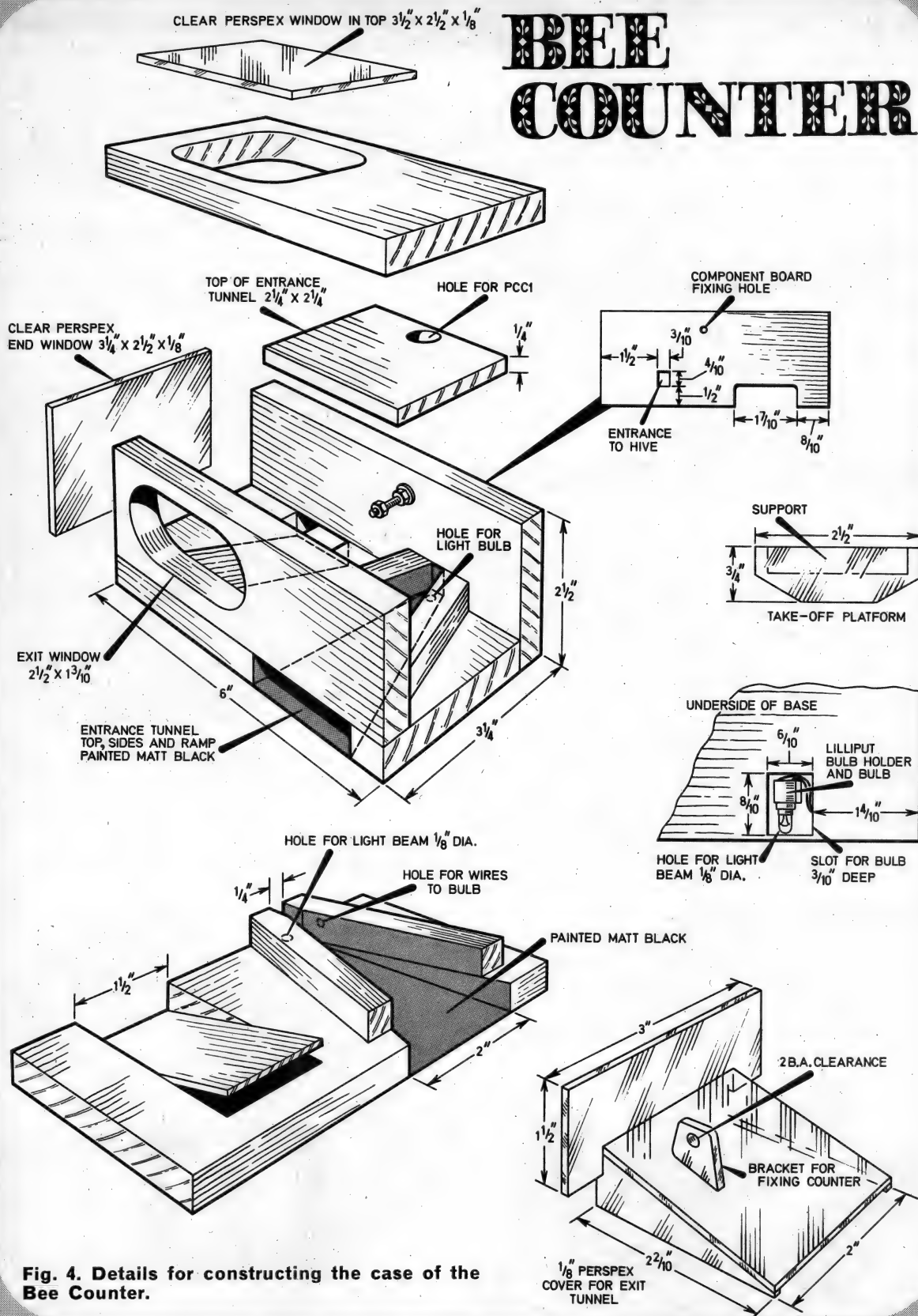


**Fig. 3. Dimensions of the end made from Paxlin to accommodate the wander sockets for battery connection, and counter readout.**





# BEE COUNTER



**Fig. 4. Details for constructing the case of the Bee Counter.**

A photograph of the prototype with top and tunnel lid (which holds PCC1 in position) removed. The photograph clearly shows the entrance and exit tunnels (labelled IN and OUT respectively). The take-off platform, made from Perspex, is located just beneath the exit cut-out, and is glued in position with Perspex adhesive.



### EXIT AND ENTRANCE GEOMETRY

As said before, this device and its design utilises the bees' senses of smell and sight. From inside the hive, the exit from the hive appears as a bright opening to the outside world and so the exit path through the instrument must be a tunnel with transparent sides and top to allow this condition to be fulfilled.

In the instrument this tunnel slopes upwards so that when the bee emerges, it finds itself on a platform of Perspex, about  $\frac{3}{4}$  in. wide, situated above the hive base, and flies away.

When it returns, it will land on the hive base (landing/alighting board) and walk towards the hive.

The entrance to the hive is now through the Bee Counter which is a tunnel painted matt black; when the bee walks along the front of the instrument and reaches this tunnel it will enter.

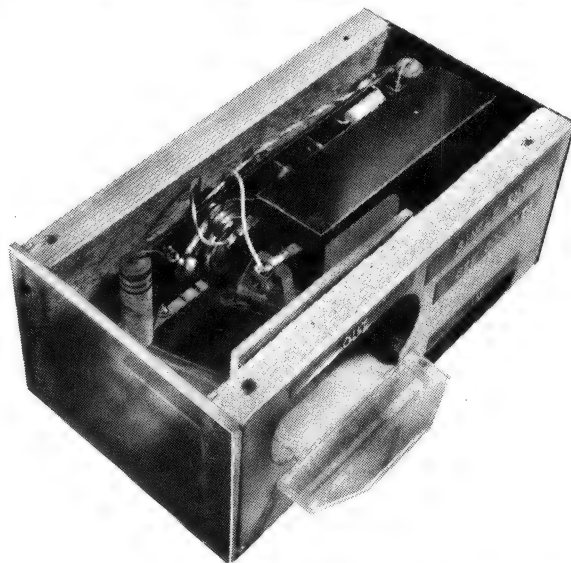
On entering, the tunnel becomes narrower and at the same time slopes upwards until it is just wide enough for a single bee to pass.

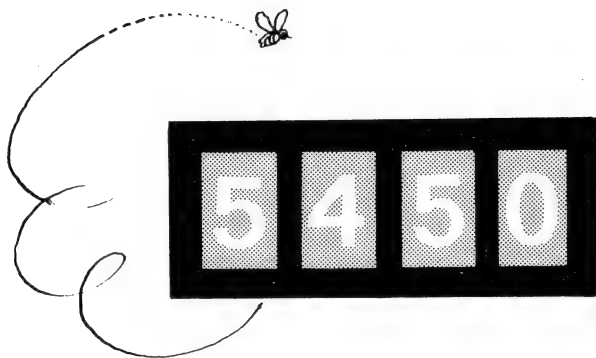
There is a lamp under the narrow part, with a hole in the floor of the tunnel, made up to the level of the floor with Perspex cement so that light can shine up through it.

The light dependent resistor is situated in the

roof of the tunnel and as the bee walks between this and the lamp, the light beam is cut and the circuit activated.

### Positions of the "electronics" within the case.





## CONSTRUCTION OF CASE

Cedar wood should be used to construct the case as this material will be readily acceptable to the bees.

Cedar wood will also withstand the weather without the need for painting but it is well to remember that if the counter is to be used in exposed outdoor conditions, weather protection becomes an important consideration, whereas in laboratory conditions it is not so.

The best compromise for an outdoor installation is a shelter which will keep off the rain.

First of all make all the wooden parts of the case as detailed in Fig. 4.

Now solder the two thin flexible covered wires to the bulb holder tags and screw in the bulb. These wires are led out through the top of the base and the bulb assembly is glued in position.

It is not likely that the bulb will need replacement because it is "under run" and there is a 20 ohm resistor (R1) in series with the bulb which reduces the light and heat dissipated in the bulb.

When the glue has set, fill up the light hole with Perspex cement so that it comes flush with the passage floor.

Glue down the two sides of the tunnel so that the width of the narrowest region is  $\frac{1}{4}$  in. Paint the tunnel top, bottom and sides a matt black.

The light dependent resistor should be a push fit into a hole in the tunnel roof.

Glue and screw the front and back to the base and glue the exit ramp in position. Drop the tunnel roof into position indicated. The other parts of the case are made from Perspex and their dimensions are given in Fig. 4.

With these made we can proceed with the assembly.

## ASSEMBLY

Begin by screwing the Perspex side and top windows in position as indicated. Glue the Perspex platform to the front and place the Perspex exit guide in position.

Now solder the two wires from the bulb holder to the component board as detailed in

Fig. 2, push the l.d.r. in position and then attach the board to the back of the case by means of a 4 B.A. nut and bolt. This bolt should be countersunk into the back so the back is flush with the front of the hive. If there is a gap here, the bees will try to go in or out through the smallest crevice.

Attach the wander sockets to the Paxolin side and solder to the appropriate flying leads from the component board. Next screw the Paxolin side to the case.

When the flying leads to the counter have been connected, fit the counter into its locating holes, (one end in the Paxolin and the other in the bracket on top of the Perspex exit guide) and secure with nuts. The counter digits should be visible through the slot in the Paxolin side.

Screw the top on and the unit is complete.

## CAPACITY AND POSITION OF CASE

The single entry counter (as this is) is only suitable for a three or four frame hive, since with a full scale hive the returning bees would sometimes overload the tunnel capacity.

The maximum a single entry counter can handle is about 60 per minute.

For a full scale hive a three entry counter is necessary. This means the entry tunnel is divided into three passages, each with its own light beam arrangement, amplifier and counter.

Whereas the single entry model is only  $6\frac{1}{4}$  in. wide, which is about right for most observation hives, it is better to make the three entry model  $16\frac{1}{2}$  in. wide so that it takes up the whole width of a Standard National hive.

When the counter is put in front of the hive the hive should be moved back by a distance equal to the depth of the Bee Counter, in this case  $3\frac{1}{4}$  in. so that the point of entry is exactly as it was without the counter.

When this is done the bees will soon get used to the new conditions and will be using the exit and entry passages without any confusion. ■

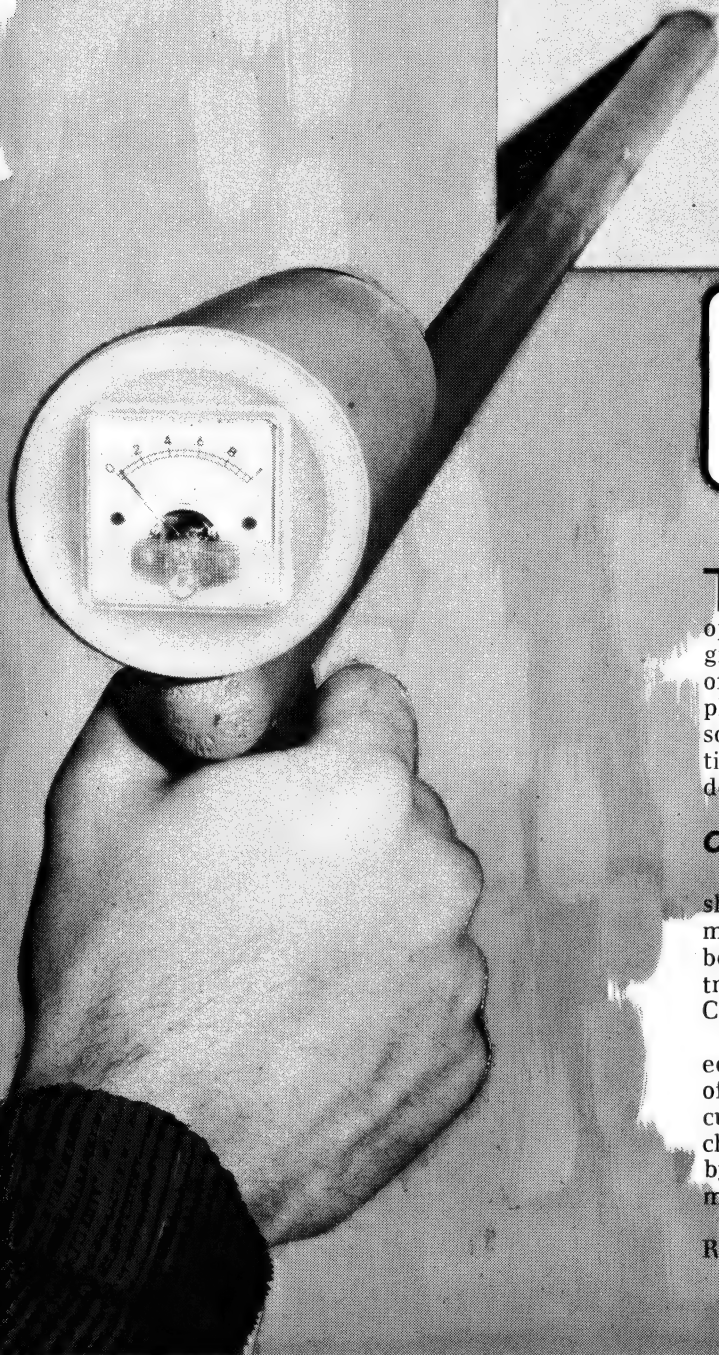




# METAL

By D. Bollen

A simple, easy to construct self-contained locator giving a meter indication of buried metal.



Approximate  
cost of  
components...  
£ 4.00 plus case

**T**HE metal locator described in this article was designed for simplicity and ease of operation. A single transistor circuit is used to give a clear meter indication of the presence of buried metal without the need for headphones or a nearby portable radio as used by some locators. Under typical operating conditions the instrument will detect a 2p coin at a depth of about 1 inch.

## CIRCUIT OPERATION

The complete circuit of the metal locator is shown in Fig. 1. Transistor TR1 acts as a common base oscillator with positive feedback between collector and emitter controlled by trimmer C4. Search coil inductor L1 is tuned by C2 to give an oscillation frequency of 100kHz.

When the circuit is functioning, L1 will induce eddy currents in nearby metal and this transfer of energy causes an increase of TR1 emitter current. Although small, the accompanying change of d.c. voltage across R3 can be detected by a sensitive null (or zero registering) voltmeter.

In Fig. 1 the d.c. null voltmeter consists of R3, R4, R5, R6 and ME1. Capacitor C5 is included

# LOCATOR

to remove unwanted a.c. from the voltmeter input, and diodes D1 and D2 protect the meter movement against overload.

At a certain setting of C4, the d.c. voltage at TR1 emitter will equal the voltage at the junction of R5 and R6 so that no current flows through ME1; this can be taken as the normal operating point for the circuit. If metal is brought close to L1, the emitter voltage of TR1 will rise by several millivolts in relation to the voltage at the junction of R5 and R6, and the meter will read.

Full scale sensitivity of the null voltmeter is around 150 millivolts. Metal Locator response is shown in Fig. 2, where meter reading is plotted against depth for three weights of metal.

## CONSTRUCTION

Commence construction by cutting a piece of 0.1 inch matrix plain perforated circuit board to a size of 3.1 by 1.4 inches, and drill holes to take C4, VR1, and S1 (see Fig. 3).

Cut two brackets from a length of  $\frac{1}{2}$  inch aluminium angle and drill to accept the meter terminal screws and 6B.A. circuit board mounting screws.

Bolt the brackets to the circuit board, complete with solder tags, and insert all terminal pins in the positions shown in Fig. 3.

With C4, VR1, and S1 in place on the circuit board, proceed to mount and solder the remaining components in the following order; resistors, capacitors, wire links and leads, diodes and the transistor, using a heat shunt to protect the diodes and transistors while soldering them.

Obtain a plastic beaker with lid (of minimum dimensions 5 inches high by  $2\frac{1}{2}$  inches diameter) and cut away the centre of the lid to accept the meter ME1. Next, drill holes in the beaker for L1 leads, woodscrews, and to allow access to the circuit board controls, see Fig. 4.

When following the step-by-step instructions in Fig. 5, for making up the search coil L1, ensure that the pile windings can slide easily off the 5 inch diameter former. Short strips of insulating tape, placed sticky side out around the former, will hold the turns together and facilitate removal of the coil. Do not use Sello-tape for this purpose as it is likely to damage the wire.

The metal locator frame (Fig. 4 and 6) consists of a chipboard or plywood handle, a  $\frac{5}{8}$  inch diameter dowel pole, and two s.r.b.p. or Perspex sheets for the search head. Screw and glue the handle to the pole and then glue the other end of the pole to the search head top board, this assembly can then be painted.

To complete the construction, screw the

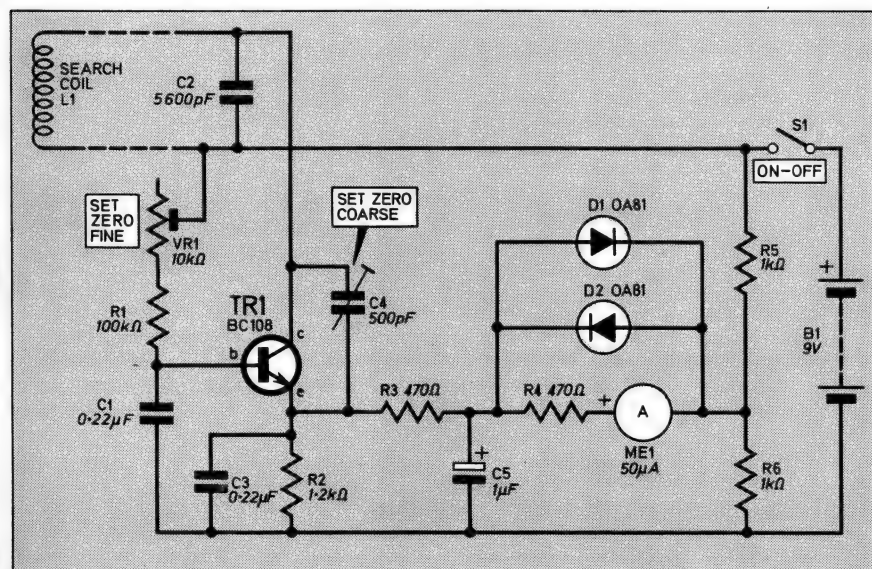


Fig. 1. Circuit diagram of the Metal Locator. The search coil L1 is mounted in the locator head and the dotted lines are the connecting wires to the circuitry.

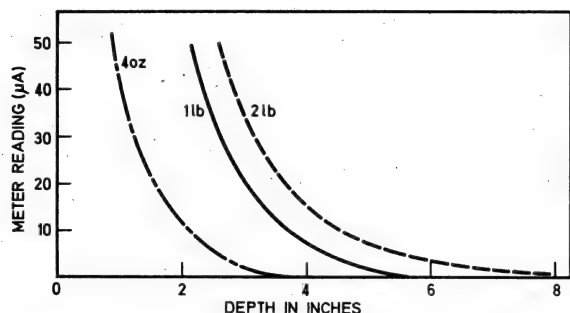


Fig. 2. Response curves of the Metal Locator.

plastic beaker to the pole opposite the handle, securely clamp the search coil between the boards, run twin leads from L1 to the beaker, and position the battery.

In the prototype, the battery was held in place behind the meter with a rubber band, as shown in the photograph, but it could equally well be fixed inside the beaker with a small clip or elastic band.

### SETTING UP

Adjust VR1 to mid track, C4 to minimum capacitance (unscrewed), and switch on. The meter pointer should go beyond full scale. With the search coil well away from metal objects, screw in C4 until the meter reads somewhere between zero and full scale. Trim for a zero reading with VR1.

### OPERATING LICENCE

The *Metal Locator* described in this article is designed to operate in the frequency band specified by the Ministry of Post and Telecommunications (16 to 150kHz). The circuit design of the locator should not be altered in any way that may affect the operating frequency.

A licence must be obtained before using the locator; this costs 75p for 5 years. An application form for a licence is obtainable from the Ministry of Post and Telecommunications, Waterloo Bridge House, Waterloo Road, London, S.E.1.

If the meter fails to read, or no response is obtained from adjustment of C4, check for wiring errors.

A certain amount of drift will be evident immediately after the locator has been switched on, therefore allow the circuit to settle down and then readjust C4 and VR1. Locator response can then be checked with metal weights and compared with Fig. 2.

Increased sensitivity can be achieved by reducing the value of C3 to 0.15µF, but this will enhance circuit drift to the point where frequent adjustment of VR1 is necessary. Conversely, drift and sensitivity will be reduced if C3 is increased in value.

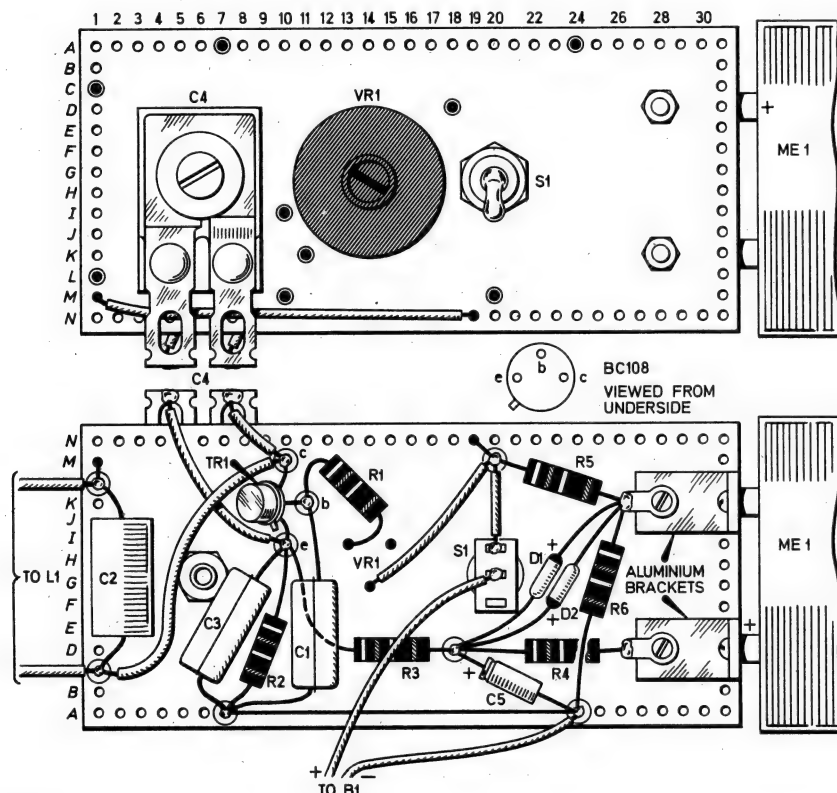
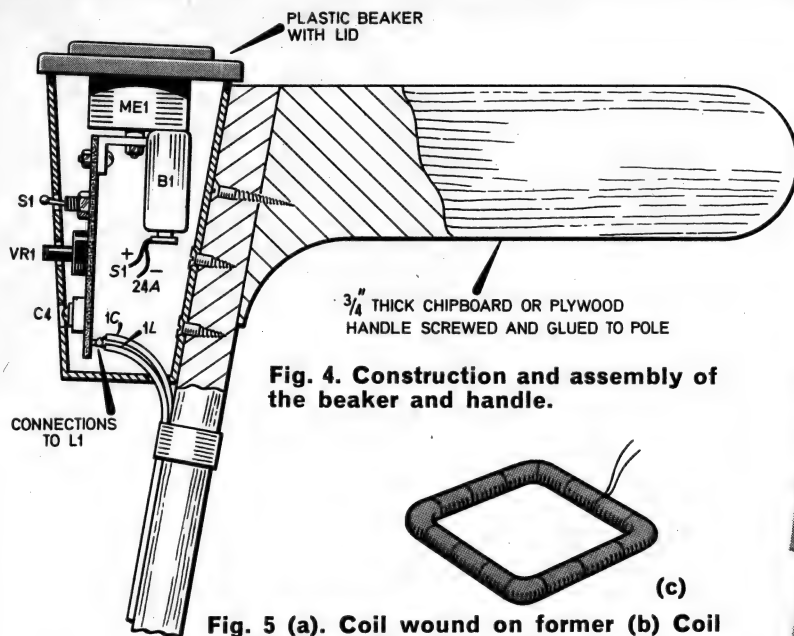
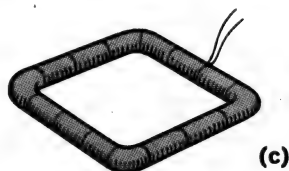


Fig. 3. Top and underside views of the circuit board and meter assembly. The circled connections represent the terminal pins used in the construction of this item. These pins are clearly indicated in the top diagram.

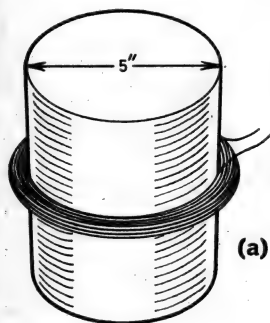




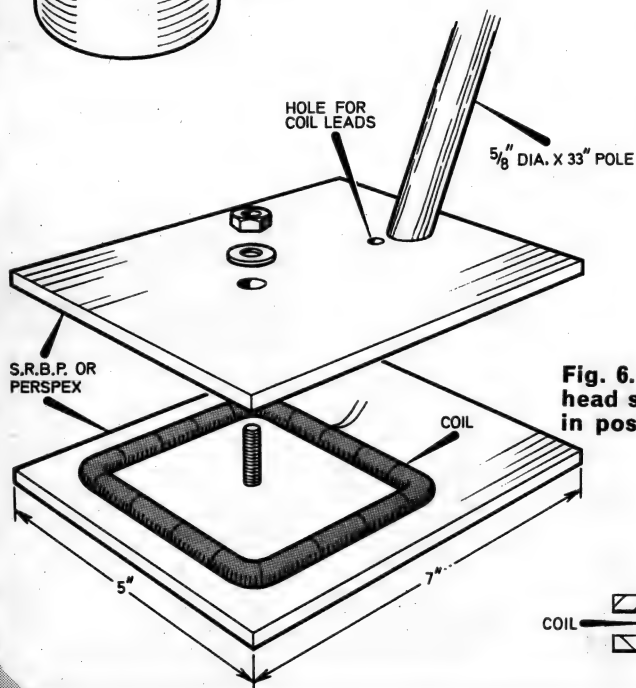
**Fig. 4. Construction and assembly of the beaker and handle.**



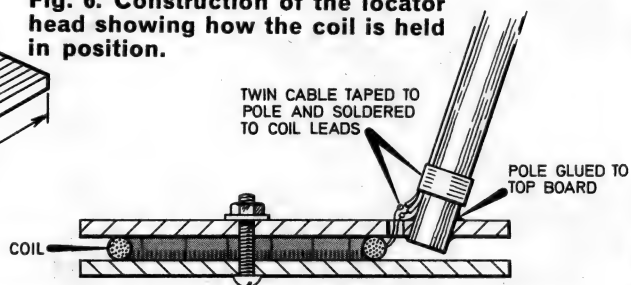
**Fig. 5 (a). Coil wound on former (b) Coil removed from former and bound with tape (c) Shaped coil.**



# METAL LOCATOR



**Fig. 6. Construction of the locator head showing how the coil is held in position.**



## Components....

### Resistors

R1 100k $\Omega$   
R2 1.2k $\Omega$   
R3 470 $\Omega$   
R4 470 $\Omega$   
R5 1k $\Omega$   
R6 1k $\Omega$

All  $\pm 10\%$   $\frac{1}{2}$  watt carbon.

### Capacitors

C1 0.22 $\mu$ F polyester 250V  
C2 5,600pF polystyrene  
C3 0.22 $\mu$ F polyester 250V  
C4 500pF mica compression trimmer  
C5 1 $\mu$ F elect. 12V

### Semiconductors

TR1 BC108 silicon *n*pn  
D1 OA81  
D2 OA81

### Meter

ME1 50 $\mu$ A f.s.d. moving coil. SEW type  
MR 38P

### Switch

S1 S.P.S.T. sub-miniature toggle

### Miscellaneous

VR1 10k $\Omega$  miniature carbon T.V. type preset  
B1 PP3 battery. Circuit board 3.1 inch by 1.4 inch plain, perforated 0.1 inch matrix Veroboard and Veropins. 26 s.w.g. cotton covered or enamelled copper wire, plastic beaker (see text), connecting wire, wood and screws for assembly,  $\frac{1}{2}$ in aluminium angle for brackets.

SEE  
**SHOP  
TALK**

## USE

The locator is now ready for use and can be used for beachcombing or searching the back garden or waste ground. The locator may be subjected to damp and the pole, in particular, should be painted for protection if nothing else.

Photograph showing the construction of the circuit board and meter mounted on the beaker lid.

Continued from page 361

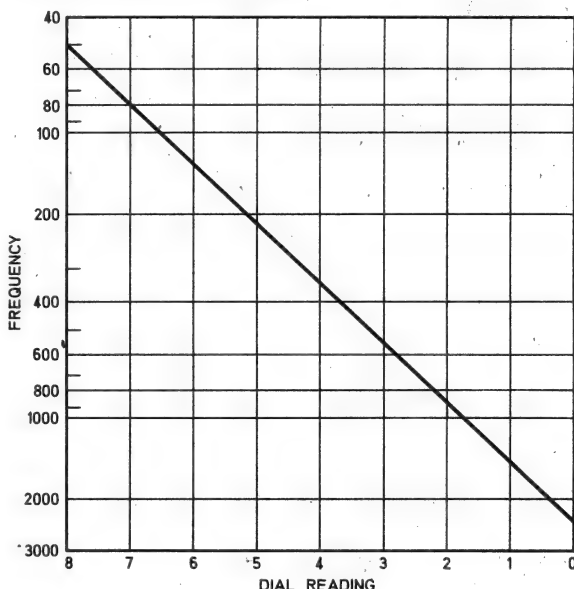


Fig. 8. Approximate output frequency for various control settings.

## FINAL ASSEMBLY

Final assembly amounts to attaching the front panel to the box frame with self tapping screws, fitting the battery inside and fitting rear panel.

The generator can be connected to the input of any amplifier but the signal output level should be adjusted in accordance with that required by the amplifier input. To comply with the calibration chart given in Fig. 8 turn VR1 fully anti-clockwise and fix the frequency control knob to read zero. The output control knob is fixed in the same way i.e., to read zero with VR2 fully anti-clockwise.

The Audio Tone Generator is now ready for use and can be tried out in conjunction with a tape recorder.



# BRAND NEW GUARANTEED

# LARGEST SELECTION OF SEMICONDUCTORS COMPONENTS

# RETURN OF POST SERVICE

## TRANSISTORS

2G301	20p	2N3404	32p	40310	45p	BC212L	13p	BSX28	32p	NKT281	27p
2G302	20p	2N3405	45p	40311	35p	BCX60	27p	BSX60	82p	NKT401	27p
2G303	20p	2N3414	22p	40312	47p	BCY31	30p	BSX81	82p	NKT402	90p
2G306	42p	2N3415	22p	40314	37p	BCY32	50p	BSX76	22p	NKT404	75p
2G308	40p	2N3416	27p	40315	47p	BCY33	35p	BSX77	27p	NKT404	62p
2G309	20p	2N3417	27p	40323	35p	BCY34	30p	BSX78	27p	NKT405	75p
2G371	15p	2N3570	21.25p	40324	47p	BCY38	40p	BSY10	27p	NKT406	62p
2G374	20p	2N3572	97p	40326	47p	BCY39	60p	BSY11	27p	NKT451	62p
2G381	22p	2N3605	27p	40329	30p	BCY40	50p	BSY24	15p	NKT452	62p
2N404	22p	2N3606	27p	40344	27p	BCY42	15p	BSY25	15p	NKT453	47p
2N696	20p	2N3607	22p	40345	57p	BCY43	15p	BSY26	15p	NKT454	30p
2N697	17p	2N3702	11p	40348	57p	BCY44	32p	BSY27	17p	NKT613F	32p
2N698	25p	2N3703	10p	40360	40p	BCY58	22p	BSY28	17p	NKT674F	32p
2N706	12p	2N3704	11p	40361	47p	BCY59	22p	BSY29	22p	NKT677F	30p
2N705A	12p	2N3705	10p	40362	47p	BCY60	97p	BSY32	25p	NKT713	25p
2N708	15p	2N3706	09p	40370	32p	BCY70	20p	BSY36	25p	NKT751	30p
2N709	62p	2N3707	11p	40406	57p	BCY71	20p	BSY37	25p	NKT0419	30p
2N718	25p	2N3708	09p	40407	40p	BCY72	17p	BSY38	22p	NKT10439	37p
2N726	30p	2N3709	09p	40408	52p	BCZ10	27p	BSY39	22p		
2N727	30p	2N3710	09p	40410	62p	BCZ11	42p	BSY40	32p	NKT10519	32p
2N914	17p	2N3711	12p	40467A	57p	BD116	21.12p	BSY51	32p		
2N916	17p	2N3715	11.25p	40468A	57p	BD121	65p	BSY52	32p	NKT20329	37p
2N918	20p	2N3716	11.80p	40600	57p	BD123	82p	BSY53	37p		
2N929	22p	2N3819	22.06p	AC107	20p	BD124	90p	BSY54	40p	NKT20339	37p
2N930	27p	2N3821	35p	AC126	20p	BD131	75p	BSY56	90p		
2N1090	22p	2N3823	97p	AC127	25p	BD132	85p	BSY78	47p	NKT80111	77p
2N1091	22p	2N3854	27p	AC128	20p	BDY10	11.37p	BSY79	45p		
2N1131	25p	2N3854A	27p	AC134	22p	BDY11	11.62p	BSY82	52p	NKT80112	97p
2N1132	25p	2N3855	27p	AC176	35p	BDY17	11.50p	BSY83	52p		
2N1302	17p	2N3856A	32p	AC187	62p	BDY18	11.75p	BSY95A	12p	NKT80113	11.12p
2N1303	17p	2N3856B	30p	AC188	37p	BDY19	11.97p	BSW41	42p		
2N1304	22p	2N3856A	30p	AC188	37p	BDY20	11.12p	BSW70	27p	NKT80211	92p
2N1305	22p	2N3858	25p	ACY18	25p	BDY38	97p	C111	75p		
2N1306	25p	2N3858A	30p	ACY19	25p	BDY60	11.25p	C424	27p	NKT80212	92p
2N1307	25p	2N3859	27p	ACY20	25p	BDY61	11.25p	C425	55p		
2N1308	25p	2N3859A	32p	ACY21	25p	BDY62	11.00p	C426	40p	NKT80213	92p
2N1309	20p	2N3860	27p	ACY22	20p	BF15	55p	C428	37p		
2N1307	17p	2N3866	11.50p	ACY28	20p	BF17	47p	G744	30p	NKT80214	92p
2N1613	25p	2N3877	40p	ACY40	20p	BF163	37p	D16P1	37p		
2N1631	35p	2N3877A	40p	ACY41	25p	BF167	18p	D16P2	40p	NKT80215	92p
2N1632	30p	2N3900	37p	ACY44	40p	BF173	19p	D16P3	37p		
2N1638	27p	2N3900A	40p	AD140	52p	BF174	30p	D16P4	37p	NKT80216	92p
2N1639	27p	2N3901	37p	AD149	57p	BF175	30p	GET102	30p		
2N1671B	11.00p	2N3903	35p	AD150	37p	BF179	30p	GET113	30p	OC20	75p
2N1711	25p	2N3904	35p	AD161	37p	BF180	35p	GET114	20p	OC22	50p
2N1889	32p	2N3905	37p	AD162	37p	BF181	32p	GET118	20p	OC23	60p
2N1893	37p	2N3906	37p	AF106	42p	BF184	25p	GET119	20p	OC24	60p
2N2147	82p	2N4058	17p	AF115	25p	BF185	42p	GET120	20p	OC25	45p
2N2148	57p	2N4059	17p	AF116	25p	BF194	17p	GET173	12p	OC26	27p
2N2160	57p	2N4060	12p	AF116	25p	BF195	15p	GET180	30p	OC28	62p
2N2193	40p	2N4061	12p	AF117	25p	BF196	42p	GET187	30p	OC29	62p
2N2193A	42p	2N4062	12p	AF118	62p	BF197	42p	GET189	22p	OC35	50p
2N2194A	30p	2N4244	47p	AF119	20p	BF198	42p	GET190	22p	OC36	62p
2N2217	27p	2N4285	17p	AF124	22p	BF200	52p	GET196	22p	OC41	22p
2N2218	25p	2N4286	17p	AF125	14p	BF204	14p	GET197	22p	OC42	25p
2N2219	25p	2N4287	17p	AF126	20p	BF225	19p	GET198	22p	OC44	20p
2N2220	25p	2N4288	17p	AF127	17p	BF237	23p	GET199	22p	OC45	12p
2N2221	25p	2N4289	17p	AF139	37p	BF238	23p	GET200	22p	OC46	15p
2N2222	30p	2N4290	17p	AF178	42p	BF244	23p	GET201	22p	OC70	15p
2N2270	47p	2N4291	17p	AF179	72p	BFW61	47p	GET202	22p	OC71	12p
2N2287	20p	2N4292	12p	AF180	42p	BFX12	22p	GET203	22p	OC72	12p
2N2288	17p	2N4303	47p	AF181	42p	BFX13	22p	GET204	22p	OC74	32p
2N2369	17p	2N5027	52p	AF239	42p	BFX29	30p	GET205	22p	OC75	22p
2N2369A	17p	2N5028	57p	AF279	47p	BFX30	30p	GET206	22p	OC76	22p
2N2410	42p	2N5029	47p	AF280	62p	BFX42	37p	GET207	22p	OC77	30p
2N2483	27p	2N5030	47p	AF211	32p	BFX44	37p	GET208	22p	OC81D	20p
2N2484	42p	2N5031	12p	AF212	35p	BFX45	67p	GET209	22p	OC82	25p
2N2530	22p	2N5174	52p	ASV27	27p	BFX84	25p	GET210	22p	OC83	25p
2N2540	22p	2N5175	52p	ASV28	27p	BFX85	32p	GET211	22p	OC84	25p
2N2613	35p	2N5176	45p	ASV29	27p	BFX86	25p	GET212	22p	OC139	32p
2N2614	30p	2N5232A	30p	ASV36	25p	BFX87	27p	GET213	22p	OC140	32p
2N2646	52p	2N5245	45p	ASV30	25p	BFX88	25p	GET214	22p	OC141	32p
2N2696	32p	2N5246	42p	ASV31	32p	BFX89	62p	GET215	22p	OC171	30p
2N2711	25p	2N5247	42p	ASV34	25p	BFX90	62p	GET216	22p	OC200	40p
2N2712	25p	2N5265	22.25p	ASV86	32p	BFY10	70p	GET217	22p	OC201	60p
2N2713	27p	2N5266	22.75p	AU103	11.25p	BFY11	42p	GET218	22p	OC202	75p
2N2714	30p	2N5267	22.82p	AU221	42p	BFY17	42p	GET219	22p	OC203	42p
2N2865	62p	2N5305	37p	BC107	10p	BFY18	32p	GET220	22p	OC204	42p
2N2904	30p	2N5306	47p	BC108	10p	BFY19	32p	GET221	22p	OC205	90p
2N2904A	30p	2N5307	37p	BC109	10p	BFY20	11.60p	GET222	22p	OC207	75p
2N2905	37p	2N5308	37p	BC113	15p	BFY21	42p	GET223	22p	OC207P	42p
2N2906A	40p	2N5309	62p	BC115	15p	BFY24	45p	GET224	22p	OC212	50p
2N2906	25p	2N5310	42p	BC116A	15p	BFY25	25p	GET225	22p	OC213	62p
2N2906A	27p	2N5354	47p	BC118	10p	BFY26	20p	GET226	22p	OC214	22p
2N2907	30p	2N5355	27p	BC121	20p	BFY29	50p	GET227	22p	OC215	22p
2N2923	15p	2N5356	32p	BC122	20p	BFY30	50p	GET228	22p	OC216	22p
2N2924	15p	2N5365	47p	BC125	20p	BFY41	50p	GET229	22p	OC217	22p
2N2925	15p	2N5366	32p	BC126	20p	BFY43	62p	GET230	22p	OC218	22p
2N2926	15p	2N5367	37p	BC140	37p	BFY60	30p	GET231	22p	OC219	22p
Green	14p	2N5457	37p	BC147	10p	BFY61	20p	GET232	22p	OC220	22p
Yellow	12p	2N5005	75p	BC148	10p	BFY62	20p	GET233	22p	OC221	22p
Orange	12p	2N5009	75p	BC149	10p	BFY63	12p	GET234	22p	OC222	22p
2N3011	30p	2N5102	50p	BC152	17p	BFY66A	57p	GET235	22p	OC223	22p
2N3014	32p	2N5103	25p	BC157	20p	BFY75	30p	GET236	22p	OC224	22p
2N3053	18p	2N5104	25p	BC158	11p	BFY76	42p	GET237	22p	OC225	22p
2N3054	40p	2N5105	32p	BC159	12p	BFY77	42p	GET238	22p	OC226	22p
2N3055	62p	2N5106	35p	BC160	62p	BFY78	62p	GET239	22p	OC227	22p
2N3133	30p	2N5107	37p	BC167	11p	BFY79	15p	GET240	22p	OC228	22p
2N3134	30p	2N5108	40p	BC168B	10p	BFW69	25p	GET241	22p	OC229	22p
2N3135	25p	2N5128	70p	BC168C	11p	BFW60	25p	GET242	22p	OC230	22p
2N3136	25p	2N5140	77p	BC169B	11p	BPX25	21.85p	GET243	22p	OC231A	50p
2N3390	25p	2N5141	72p	BC169C	12p	BPX29	21.80p	GET244	22p	OC232A	50p
2N3391	30p	2N5142	55p	BC170	12p	BPX10	11.45p	GET245	22p	OC233A	75p
2N3392	30p	2N5143	67p	BC171	15p	BPX11	15p	GET246	22p	OC234	75p
2N3393	17p	2N5152	57p	BC172	15p	BPX19	17p	GET247	22p	OC235	75p
2N3394	15p	2N5153	57p	BC173	22p	BPX20	17p	GET248	22p	OC236	75p
2N3395	15p	2N5154	57p	BC174	22p	BPX21	17p	GET249	22p	OC237	75p
2N3396	15p	2N5155	57p	BC175	22p	BPX22	17p	GET250	22p	OC238	75p
2N3397	15p	2N5156	57p	BC176	22p	BPX23	17p	GET251	22p	OC239	7



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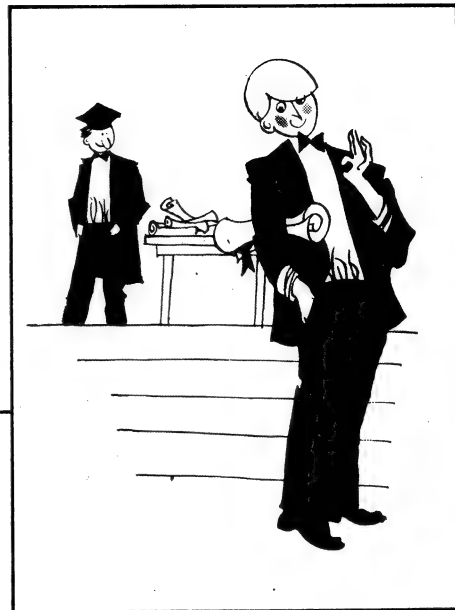
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# TEACH-IN

## Half term test

# ANSWERS



Last month we posed some problems under the heading *Teach in Half-Term Test*. We will now answer those problems and try to show how we arrived at the answers. If you have got some of them wrong do not worry, just try and follow our explanation and see where you went wrong.

(1) They flow from negative to positive in reality. Although we assume that conventional current flows from positive to negative the actual electrons flow from negative to positive.

(2) (b)  $\mu\text{A}$  (microamps), (e) A (amps)

(3) 22 volts.  $V = IR$  hence  $V = 0.01 \times 2.2 \times 1,000 = 22\text{V}$

(4) It does not matter. All the resistor does is to limit the current; this can be done at any point around the circuit.

(5) 2.8mA. Total resistance is  $2.2\text{k}\Omega + 1\text{k}\Omega = 3.2\text{k}\Omega$ .

$$\text{Current flow } I = \frac{V}{R} = \frac{9}{3.2 \times 1,000} = 2.8 \div 1,000 \text{A} = 2.8\text{mA}$$

(6)  $R_1$  and  $R_3 \frac{1}{2}\text{W}$ ,  $R_2 1\text{W}$ . Total circuit resistance

$$R_T = R_1 + \frac{R_2 \times R_3}{R_2 + R_3} = 10 + 33.3 = 43.3\Omega$$

$$\text{Total current } I = \frac{V}{R} = \frac{9}{43.3} = 0.21\text{A}$$

Dissipation of  $R_1 = I^2 R = 0.21 \times 0.21 \times 10 = 0.44\text{W}$ . The nearest commercial rating is  $\frac{1}{2}\text{W}$ . Next calculate the voltage drop across  $R_2$  and  $R_3$  together  $V = IR = 0.21 \times 33.3 = 7\text{V}$ .

We know that  $W = I^2 R$ , but  $I = \frac{V}{R}$  therefore

$$W = \frac{V}{R} \times \frac{V}{R} \times R \text{ and, cancelling } W = \frac{V^2}{R}$$

$$\text{Dissipation in } R_2 = \frac{V^2}{R} = \frac{7 \times 7}{50} = \frac{49}{50} = 0.98\text{W}$$

$$\text{Dissipation in } R_3 = \frac{V^2}{R} = \frac{49}{100} = 0.49\text{W}$$

(7) 0.4W or 400mW. Maximum dissipation occurs when the value of  $VR_1$  equals that of  $R_1$  i.e.  $50\Omega$ . When both resistors are of equal value the voltage drop across each is half the voltage drop across both, therefore, maximum dissipation in  $VR_1$

$$= \frac{V^2}{R} = \frac{4.5 \times 4.5}{50} = \frac{20.25}{50} = 0.405\text{W}$$

(8) (a)  $4.7\text{k}\Omega \pm 10\%$

(b)  $22\text{k}\Omega \pm 5\%$

(c)  $100\text{k}\Omega \pm 10\%$

(9) (b)  $20\mu\text{F}$  40V. In most applications using electrolytic capacitors the capacitance must be greater than a certain value; the tolerance of a normal  $16\mu\text{F}$  would encompass  $20\mu\text{F}$ . The important thing is that the working voltage is the same or greater.

(10) Reject it politely. He has given you a  $120,000\text{pF}$  or  $0.12\mu\text{F}$  capacitor. Check to see if he has the precise value and, if he does not, you may as well take this one, since it should be near enough to use as a substitute.

(11)  $C_1$  will charge up the fastest as it has the lowest value and is being charged through the lowest value resistor.

(12)  $C_2$  will take the longest time to charge, as it has the highest value and is being charged through the highest value resistor.

(13) Forward biased. The conventional current flows from positive to negative and can thus flow through the diode in the direction of the arrow.

(14) 100V and 100mA. Peak reverse breakdown voltage will be the battery voltage. Since in the reversed biased condition there is negligible current flowing  $R_1$  will not drop any voltage and the full supply voltage will appear across  $D_1$ . In the forward biased condition the diode can be assumed to be a short circuit thus only  $R_1$  can limit the current flowing hence

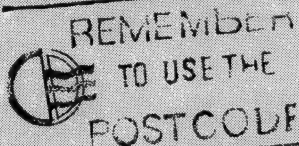
$$I = \frac{V}{R} = \frac{100}{1 \times 1,000} = 0.1\text{A or } 100\text{mA}$$

(15) (d) 100V, 150mA. Both ratings given are minimum ratings,  $0.1\text{A} = 100\text{mA}$ .

(16) (b) 0.6V. As the diode is forward biased the voltage would be 0.6V. There is always a voltage drop of approximately 600mV across silicon diodes due to the "knee" in the characteristic.

Well, how did you fare? If you got them all right that is excellent, if you did not the important thing is that you understand where you had difficulties. We suggest that you re-read the relevant sections of the *Teach-In* series.

We hope that you found the questions a challenge and at the same time they have opened your eyes to some calculation methods—particularly the calculation of dissipation. If you used  $W = I^2 R$  instead of deriving  $W = \frac{V^2}{R}$  this does not matter but it may pay to look for an easier way next time.



# Readers Letters

## Bias Value

Having been a subscriber to P.E. and P.W. "off and on" for about 10 years I came across the January issue of EVERYDAY ELECTRONICS, which had my instant approval and now joins the rank of my other magazine's culminating in an endless and very informative pile on top the piano.

I find it is a magazine not only of theoretical enthusiasm but of great practical interest to the "everyday handyman" and certain to be a book for beginners, especially the very helpful facts "projected" by Mike Hughes, M.A.

I would hope in the future that perhaps Mr. Hughes could give reference to finding values of bias resistors, etc., needed for the satisfactory operation of different transistor parameters, and also relevant circuit operation of thyristors, unijunction and field effect transistors and other very useful flexible types of semiconductors.

Noticing other readers' troubles referring to the *Electro Laugh*, I also constructed this article and it worked first time owing to the way I adopt when working on, or constructing any project, I always check the finished article with the actual circuit diagram thus finding our little friend Q7 and P7.

Unfortunately the only earphone I had was a high impedance crystal type, but by connecting a resistor in the region of 250 ohms in parallel with it, it brought the overall impedance down to a satisfactory level with a slight reduction in volume.

J. Mason  
S. Wales

*We doubt if Teach-In will be able to meet all your needs as it will finish after 12 months. However we will be publishing further series that should help.*

## Another Bug

Naturally, I was quite flattered to discover that you had found my letter sufficiently interesting for inclusion in *Readers Letters* (March issue), however, I must admit that my pleasure was mixed with large helpings of disappointment and frustration due to your editing of the letter.

I am not complaining at all about the amount of space allocated to my comments—I realise you have the right to include only that which in your wisdom you decide is worthy of publication.

My complaint is that you have entirely neglected to make even a brief reference to what was after all the main point of my letter—the difficulty of obtaining items advertised in your magazine. By omitting any reference to this frustrating situation, my letter as printed is sailing under false colours—the few minor constructional queries were in fact, sorted out by trial and error once I got going. The real reason for being unable to get cracking was not so much mounting components, as actually getting hold of them!

The fact that you completely ignored my comments regarding suppliers leads me to two conclusions:

(One) That you accepted my comments to be an exaggeration of a somewhat hysterical nature, and were not a true picture of the real situation, or

(Two) That you accepted my statements as correct, but did not wish to offend your advertisers whose business you must obviously wish to retain.

With regard to the former, I feel I must now justify my remarks by quoting a few of the more deplorable examples of SERVICE, and leave you to form your own conclusions. These examples are on a separate sheet herewith enclosed.

Regarding (Two), whilst I

realise that you are not to be held responsible for goods or services advertised in your columns, you do, however, have a moral responsibility to your readers. After all, it is you that place these offers before us, the readers, and if for example, I had not seen a certain item offered in your magazine, then I would have been saved the trouble and frustration that followed when the item failed to arrive, and all attempts to obtain satisfaction are largely ignored.

However, I have now found a couple of very good suppliers whose friendly, courteous, and extremely efficient service have allowed me to obtain some of the pleasure that I had hoped would be derived from my new hobby (Galleon Trading Co. and Radio Exchange Co.).

To date I have completed several very efficient radios, some from kits; also the *Astron*, a general purpose amplifier, and one or two other gadgets, and success rate so far is quite satisfactory, so the situation is not too black after all.

J. G. Richards  
Sale, Cheshire

*The above correspondent supplied us with details of orders placed with four different advertisers, none of which had been expediently dealt with, at the time of writing.*

*We have investigated all of these cases on behalf of our reader. The delays, regrettable as they are, seem to be unavoidable and can be largely attributed to the phenomenal success of this magazine's declared intention to popularise the hobby of electronics!*

*As a consequence, our advertisers are sometimes overwhelmed by a flood of orders, and delays do therefore sometimes arise. But we know all our advertisers make determined efforts to clear their back-log of orders as quickly as possible.*

*We, on our part, will always investigate any serious and reasonable complaints, on behalf of our readers.*

## Cell Life

I have just read the March issue of EVERYDAY ELECTRONICS and thoroughly appreciated the *Ruminations* by Sensor where he mentioned the tin saw and how much damage could result to a

*Everyday Electronics, May 1972*



## MULTI-SPEED MOTOR

Six speeds are available 500, 850 and 1,100 r.p.m. and 8,000; 12,000 & 15,500 r.p.m. shaft is  $\frac{1}{2}$  in. diameter 230/240v. Its speed may be further controlled with the use of our Thyristor controller. Very powerful and useful motor size approx. 2 in. dia. x 5 in. long. Price 85p plus 23p postage and insurance.



## RESETTABLE FUSE

How long does it take you to renew a fuse? Time yourself when next one blows. Then reckoning your time at £1 per hour see how quickly our resettable fuse (auto circuit breaker) will pay for itself. Price only £1 each or £11 per dozen, specify 5, 10 or 15 amp—simply fit in place of switch.

## MAINS TRANSISTOR POWER PACK

Designed to operate transistor sets and amplifiers. Adjustable output 6v., 9v., 12 volts for up to 500mA (class B working). Takes the place of any of the following batteries: PP1, PP3, PP4, PP6, PP7, PP9 and others. Kit components: mains transformer rectifier, smoothing and load resistor, condensers and instructions. Real snip at only 85p, plus 20p postage.

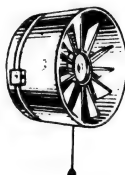
## MICRO SWITCH

5 amp. changeover contacts, 9p each, 11 doz. 15 amp. Model 10p each or £1.05 doz.



## EXTRACTOR FAN

Cleans the air at the rate of 10,000 cubic ft. per hour. Suitable for kitchens, bathrooms, factories, changing rooms, etc. It's so quiet it can hardly be heard. Compact, 5 $\frac{1}{2}$ " casing with 5 $\frac{1}{2}$ " fan blades. Kit comprises motor, fan blades, sheet steel casing, pull switch, mains connector, and fixing brackets, £2 plus 36p post and ins.



## MAINS MOTOR

Precision made—as used in record decks and tape recorders—ideal also for extractor fan, blower, heaters, etc. New and perfect. Snip at 50p. Postage 15p for first one then 5p for each one ordered.



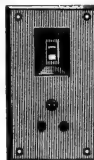
## THERMOSTAT

Continuously variable 50°-90° C. Has sensor bulb connected by 33in. of flexible tubing. On operation a 15 amp 250 volt switch is opened and in addition a plunger moves through approx  $\frac{1}{2}$  in. This could be used to open valve on ventilator etc. £1.50 plus 23p p. & ins.



## 5A 3-PIN SWITCHED SOCKETS

An excellent opportunity to make that bench die board you have needed or to stock up for future jobs. This month we offer 6 British made (Hicraft) bakelite flush mounting shuttered switch sockets for only 50p plus 18p post and insurance. (20 boxes post free).



## MAINS OPERATED SOLENOIDS

Model 772—small but powerful 1" pull—approx. size 1 $\frac{1}{2}$ " x 1 $\frac{1}{2}$ " x 1 $\frac{1}{2}$ ". 60p.  
Model 400/1 1" pull. Size 2 $\frac{1}{2}$ " x 2" x 1 $\frac{1}{2}$ ". 75p.  
Model TT10 1 $\frac{1}{2}$ " pull. Size 3" x 2 $\frac{1}{2}$ " x 2 $\frac{1}{2}$ ". £1.80 plus 20p post and insurance.

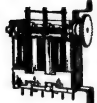


## TELESCOPIC AERIAL

for portable, car radio or transmitter. Chrome plated—six sections, extends from  $\frac{7}{8}$  to 47in. Hole in bottom for 6BA screw. 35p. 89p. KNUCKLED MODEL FOR F.M. 50p.

## 3 STAGE PERMEABILITY TUNER

This Tuner is a precision instrument made by the famous 'Clydon' Company for the equally famous Radiomobile Car Radio. It is a medium wave tuner (but set of longwave coils available 25p) with a frequency coverage 1620 Kc/s-505 Kc/s and intended to operate with an I.F. value of 470 Kc/s. Extremely compact (size only 2 $\frac{1}{2}$ " x 2" x  $\frac{1}{2}$ ins. thick) with reduction gear for fine tuning. Snip price this month 60p, with circuit of front end suitable for car radio or as a general purpose tuner for use with Amplifier. Post free.



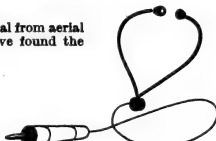
## CAPACITOR DISCHARGE CAR IGNITION

This system which has proved to be amazingly efficient. We offer kit of parts as PW circuit £5-95 plus 20p p. & p. De-luxe model with prepared circuit board £6-65. When ordering please state whether for positive or negative systems.

## ELECTRONIC IGNITION

## RADIO STETHOSCOPE

Easiest way to fault find—traces signal from aerial to speaker—when signal stops you've found the fault. Use it on Radio, TV, amplifier, anything—complete kit comprises two special transistors and all parts including probe tube and crystal earpiece. £2—twin stethoscope instead of earpiece 75p extra post and ins. 20p.



## STANDARD WAFER SWITCHES

Standard size 1 $\frac{1}{2}$ " wafer—silver-plated 5-amp contact, standard  $\frac{1}{2}$ " spindle 2" long—with locking washer and nut.

No. of Poles	2 way	3 way	4 way	5 way	6 way	8 way	9 way	10 way	12 way
1 pole	40p	40p	40p	40p	40p	40p	40p	40p	40p
2 poles	40p	40p	40p	40p	40p	40p	40p	40p	40p
3 poles	40p	40p	40p	40p	40p	40p	40p	40p	40p
4 poles	40p	40p	40p	40p	40p	40p	40p	40p	40p
5 poles	40p	40p	40p	40p	40p	40p	40p	40p	40p
6 poles	40p	40p	40p	40p	40p	40p	40p	40p	40p
7 poles	40p	40p	40p	40p	40p	40p	40p	40p	40p
8 poles	40p	40p	40p	40p	40p	40p	40p	40p	40p
9 poles	40p	40p	40p	40p	40p	40p	40p	40p	40p
10 poles	40p	40p	40p	40p	40p	40p	40p	40p	40p
11 poles	40p	40p	40p	40p	40p	40p	40p	40p	40p
12 poles	40p	40p	40p	40p	40p	40p	40p	40p	40p

## THYRISTOR LIGHT DIMMER

For any lamp up to 200 watt. Mounted on switch plate to fit in place of standard switch. Virtually no radio interference. Price £1-99 plus 20p post and insurance.



## THIS MONTH'S SNIP



1 HOUR MINUTE TIMER. Made by Smiths complete with control knob and calibrated dial. This month's special bargain at 50p. Useful in the Kitchen, Office and Dark-room etc.

## MULLARD AUDIO AMPLIFIER MODULE

Uses 4 transistors, and has an output of 750mW into 8 ohms speakers. Input suitable for crystal mic. or pick-up. 9 volt battery operated. Size 2" long x 1 $\frac{1}{2}$ " wide x 1" high. SPECIAL SNIP PRICE 60p each, 10 for £5.



## POCKET CIRCUIT TESTER

Test continuity for any low resistance circuit, house wiring, car electrics. Test polarity of diodes and rectifiers. Also ideal size for conversion to signal injector (circuit supplied), 30p or 2 for 50p. Post paid.

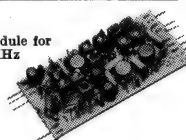


## METAL LOCATOR AUDIO TONE GENERATOR BEE COUNTER

To receive details on these kits send s.a.e. for parts list.

## MULLARD I.F. MODULE

This is a fully screened intermediate frequency module for amplification and detection of f.m. signals at 10-7MHz and a.m. signals at 470KHz. The first stage is used as an i.f. amplifier for f.m. and a self oscillating mixer for a.m. operation, in conjunction with an external oscillator coil. 75p each, 10 for £7.5. 100 for £82.50. With connection dia.



## DISTRIBUTION PANELS

Just what you need for work bench or lab. 4 x 13 amp sockets in metal box to take standard 13 amp fused plugs and on/off switch with neon warning light. Supplied complete with 6 feet of flex cable. Wired up ready to work. £2-25 plus 23p p. & i



## BATTERY CONDITION TESTER

Made by Mallory but suitable for all batteries made by Ever Ready and others, most of which are zinc carbon types but also mercury manganese-nicad—silver oxide and alkaline batteries may be tested. The tester puts a dummy load on the battery and the meter scale indicates the condition depending upon which section the pointer rests. The section reads "replace" "weak" or "good". The tester is complete in its case, size 3 $\frac{1}{2}$ " x 6 $\frac{1}{2}$ " x 2" with leads and prods. Price £1-75 plus 20p postage.



Where postage is not stated then orders over £5 are post free. Below £5 add 20p. Semi-conductors add 5p post. Over £1 post free. S.A.E. with enquiries please.

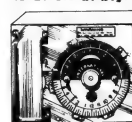
**Thermostat with Probe.** Made by the famous Ranco Thermostat Co. Covers the range from approx. 0°-200°C. variable by a control spindle, handles currents up to 16 amps. Length of capillary and sensor tube approx. 3' 6". These are ideal for ovens and as a general purpose thermostat. Price 50p each or 10 for £4-50.  
**Small Tuning Condenser** as fitted to many imported Japanese and Hong Kong radios. 2 gang about 200PF per gang. Size approx. 1" x 1" with a 1" diameter spindle with dust cover. 25p each or 10 for £2-25.  
**Heat Sink.** Small type as used with OCS1 etc. Price 5p each or 10 for 45p.  
**Spectacle Frames.** (No lenses) with built-in hearing aids. The amplifier and battery being housed in the arms. Although these are complete hearing aids we are selling them purely for the sub miniature components they contain. We give no guarantee that they are in working order also these may be secondhand. Price £2-50 each.  
**Foot Switch.** Twin levers each of which operates a 10 amp QMB changeover switch. Price 90p each.  
**Programmer.** 5 Revs per minute. Made by Magnetic Devices Ltd. The contacts may be set to trigger anywhere around the shaft, ideal for motivated lighting displays, sequential switching etc. Drive motors are 200-240v 50Hz. Model A has 5 change over contacts. Price £1-50. Model B has 11 change over contacts. Price £3-50.  
**Radiant Cooker Rings.** As fitted to Tricity and many other popular cookers. We have two types. These are copper clad  $\frac{1}{2}$ " tubular construction. Both models having an external diameter of 6 $\frac{1}{2}$ " and the elements have been slightly flattened to increase radiation.  
**Speaker Model 7DI.** With again 3000 watts rated but 230-240v, has no cover over element ends. Price 65p each or 10 for £5-85.  
**Slide Switch.** 2 pole change over panel mounting by two 6 BA screws. Size approx. 1" x  $\frac{1}{2}$ " rated 250v lamp, 6p each, 10 for 54p. 100 for £5-10. 500 for £24.  
As above but for printed circuit 5p each, 10 for 45p, 100 for £4-25.  
**Sub Miniature Slide Switch.** DPDT 19mm ( $\frac{1}{2}$ " approx.) between fixing centres. 12p each or 10 for £1-08.

## KITS FOR PREVIOUS PROJECTS.

Unless otherwise stated, kits contain electronic parts only. The case and special items can be obtained locally. Also batteries are not included. Kits may be returned for refund if construction has not been started. We reserve the right to substitute components should deliveries be protracted so as to avoid undue delay.

<b>HOME SENTINEL INTRUDER ALARM</b> Electronic Components with suitable case	£2-75
<b>SNAP INDICATOR</b>	75p
<b>WINDSCREEN WIPER CONTROL</b> Components including metal for chassis	£2
<b>RECORD PLAYER.</b> All components, but not case, loudspeaker, record deck or pick-up	£5-50
<b>DEMO DECK</b>	£2-75
<b>PUZZ BOX</b>	£1-85
<b>PHOTOGRAPHIC COLOUR</b>	£2-65
<b>TEMPERATURE METER</b>	£2-65
<b>ASTRON RADIO</b>	£3
<b>REMOTE TEMPERATURE</b>	£2
<b>COMPARATOR</b>	£4-25
<b>ELECTRO LAUGH</b>	£2
<b>TRANSISTOR MICROPHONE</b>	£1-70
<b>AUTO ALERT</b> All electronic parts and metal bracket	£2-50
<b>RAIN WARNING ALARM</b> All electronic parts and chassis	£1-90
<b>WA-WA PEDAL</b>	£2-90
<b>DARKROOM TIMER</b>	£4-50
<b>SIGNAL INJECTOR</b>	80p
<b>SOIL MOISTURE METER</b>	£3-00
<b>SIMPLE CALCULATOR</b>	£2-80
<b>D.C. POWER SUPPLY</b>	£5-00
<b>BABY ALARM</b>	£4-00

**Mains Transformer.** Primary 240v. tapped 220v. Secondary 20v. 1 amp. Price 60p each or 10 for £5-40.  
**Dial Thermometer**—reading from 200-525°F used on Tricity and other cookers. This has a flange and can be mounted through a 1 $\frac{1}{2}$ " hole or alternatively it can just be rested on the object whose temperature it is required to measure. Size 2" x  $\frac{1}{2}$ " overall diameter. Depth  $\frac{1}{2}$ " below and  $\frac{1}{2}$ " above mounting panel. Price 80p each or 10 for £7-20p.



## 24-HOUR TIME SWITCH

Made by Smiths, these are AC mains operated, NOT CLOCKWORK. Ideal for mounting on rack or shelf or can be built into box with 13A socket, 2 completely adjustable time periods per 24 hours, 5 amp changeover contacts will switch circuit on or off during these periods. £2-50 post and ins. 23p. Additional time contacts 50p pair.

## J. BULL (ELECTRICAL) LTD.

(Dept. E.E.) 7 Park Street, Croydon CRO 1YD  
Callers to: 102/3 Tamworth Road, CROYDON



beginner's enthusiasm.

When I read about the *Signal Injector* by Alan Jardine I was reminded of the poor beginner.

Following the instruction to solder the leads direct on to the cell will result in heating up the electrolyte and a very short life for the cell.

Perhaps this is not important as the choice of a push-on/push-off switch allows no easy means of knowing if the thing is on or off. Very few beginners will remember to test each time, and cell life will be short it is expected. A push button perhaps?

The blind cannot be expected to lead the blind, and beginners are usually short of experience.

R. Quorn  
Sussex

*Of your two points concerning the Signal Injector, the first is a bit exaggerated. It is true that the cell life will be reduced by applying heat (from soldering iron) to the battery terminals but this is only negligible for the time required to execute the connection.*

*To install a holder to suit this type of battery would increase the cost by about 40 per cent.*

*We agree that it will be difficult to tell if the unit is on or off when not in use, but it can be determined; when the unit is "on" the push button will feel "loose" but in the "off" position this looseness disappears.*

*If this proves unsatisfactory a push-to-make release off type can be substituted.*

## More Accurate Timer

May I thank you for publishing another article combining the hobbies of electronics and photography (ref. *Darkroom Timer*, March issue).

Although of excellent design, I feel it must be stated that a timer with only a 5 second timing intervals is not nearly accurate enough for the demands of the high quality black and white or well balanced colour prints that are required. However, with a small modification, I have found that the timer may be converted to an accurate piece of equipment having a timing range of 5 to 45 seconds in one second steps.

The modification requires four extra components, which are a 5 position two-pole switch (S4), VR5, VR6 and VR7 which are

skeleton presets of the values, 5 kilohm, 10 kilohm and 20 kilohm respectively.

These components form an additional timing circuit which is connected in series with the original ( $R_4$ ).

Position 1 of the switch has no further resistance and acts as a short circuit; position 2 connects VR5 into circuit, whilst position 3 connects VR6; position 4 connects VR5 and VR6 and position 5 connects VR7 into circuit.

Each position of the new switch is to represent a further one second delay.

Position 1 of course, has no further delay, position 2 however, will give a one second delay, position 3 two seconds etc. when the presets are set as they were in the original timing circuit.

Now, any time, in one second steps may be selected from 5 to 45 seconds by selecting the required 5 second range, plus the required extra time (if any) on the new switch.

D. G. Smith  
Emsworth, Hants.

## Components

Let me say first of all how much I enjoy your magazine and as a newcomer to electronics I find your *Teach-In* articles very interesting and also *Shop Talk*, etc. However, I wonder if I may make a suggestion?

I constructed your *Demo-Deck* and find that in following this series for a month or so there is a list of the more minor components used in the experiments and I wondered if it would be at all possible, either, preferably, if you could publish the list of all the components that would be required for the rest of this series in one complete list or if possible broken up into the individual months during which they will be required.

The reason I say this is, that I,

like many of your other readers no doubt, have no local supplier of components in my immediate vicinity and it usually means a trip to Edinburgh or Glasgow to purchase these components.

However, if I could have a full list this would make things much easier for me. It would also make it much easier to send off a full list by post to a mail order firm rather than asking for two or three small components every month or so. I wonder if this could be done.

I am very grateful to you and wish you every success for your future publications.

R. L. Grant  
Scotland

*It was our intention to publish an advanced list and in future we shall be publishing, at the end of each Teach-In every month, a list of components additional to those you have already acquired.*

## Calling Gloucester

Now that I'm receiving your magazine on regular order and greatly enjoying it, I feel that I ought to go a stage further in order to get any lasting benefit from your guidance.

Can I please find out through your pages how many people in the Gloucester area are willing to ask for, and attend, an evening class on useful, basic "everyday electronics"?

Should anyone be interested, could they please write to me at the address given, then provided enough wish it, our local Education Authority can be approached with evidence that the need for such a class does exist.

Many thanks for giving me a chance to ask for these people through your very sensible magazine.

E. L. Payn  
82 Innsworth Lane,  
Longlevens,  
Gloucester  
GL2 0DE

**If you write to us for advice, and wish to have a personal reply you must include a s.a.e. Unfortunately, we cannot prepare special designs, circuits or wiring diagrams, to meet individual requirements nor can we answer queries concerning commercial equipment, or subjects or designs not published by us.**

**For all technical and editorial matters, write to: The Editor, Everyday Electronics, Fleetway House, Farringdon Street, London, E.C.4. Phone 01-634 4452.**

**For all enquiries concerning advertisements or advertisers write to: The Advertisement Manager, Everyday Electronics, at the above address. Phone 01-634 4202.**



# BI-PRE-PAK



## TELEPHONE DIALS

Standard Post Office type.  
Guaranteed in working order.

**ONLY 50p**

## COMPLETE TELEPHONES

EX-G.P.O. NORMAL HOUSEHOLD TYPE



**95p**

EACH  
P. & P.  
35p  
each.

## NEW TESTED AND GUARANTEED PAKS

B2	4	Photo Cells, Sun Batteries. 0.3 to 0.5V, 0.5 to 2mA.	50p
B79	4	IN4007 Sil. Rec. diodes. 1,000 PIV lamp plastic	50p
B81	10	Reed Switches, mixed types large and small	50p
B99	200	Mixed Capacitors. Approx. quantity, counted by weight	50p
H4	250	Mixed Resistors. Approx. quantity counted by weight	50p
H7	40	Wirewound Resistors. Mixed types and values.	50p
H8	4	BY127 Sil. Recs. 1000 PIV, 1 amp. plastic	50p
H9	2	OC771 Light Sensitive Photo Transistor	50p
H12	50	NKT155/259 Germ. diodes, brand new stock clearance	50p
H18	10	OC71/75 uncoated black glass type PNP Germ.	50p
H19	10	OC81/81D uncoated white glass type PNP Germ.	50p
H28	20	OC200/1/2/3 PNP Silicon uncoated TO-5 can	50p
H29	20	OA47 gold bonded diodes coded MCS2	50p

## NEW UNMARKED UNTESTED PAKS

B66	150	Germanium Diodes Min. glass type	50p
B83	200	Trans. manufacturers' rejects all types NPN, PNP, Sil. and Germ.	50p
B84	100	Silicon Diodes DO-7 glass equiv. to OA200, OA202	50p
B86	50	Sil. Diodes sub. min. IN914 and IN916 types	50p
B88	50	Sil. Trans. NPN, PNP equiv. to OC200/1 2N706A, BSY95A, etc.	50p
B1	50	Germanium Transistors PNP, AF and RF	50p
H6	40	250mW. Zener Diodes DO-7 Min. Glass Type	50p
H10	25	Mixed volts, 14 watt Zeners Top hat type	50p
H17	20	3 amp. Silicon Stud Rectifiers, mixed volts	50p
H15	30	Top Hat Silicon Rectifiers, 750mA. Mixed volts	50p
H16	8	Experimenters' Pak of Integrated Circuits. Data supplied	50p
H20	20	BY126/7 Type Silicon Rectifiers 1 amp plastic. Mixed volts.	50p

## MAKE A REV COUNTER FOR YOUR CAR

The 'TACHO BLOCK'. This  
encapsulated block will turn any  
0-1mA meter into a linear and  
accurate rev. counter for any  
car with normal coil ignition  
system.

**£1 each**



## OUR VERY POPULAR 3p TRANSISTORS

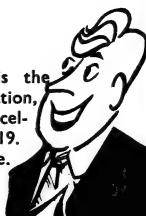
TYPE "A" PNP Silicon alloy, TO-5 can.  
TYPE "B" PNP Silicon, plastic encapsulation.  
TYPE "E" PNP Germanium AF or RF.  
TYPE "F" NPN Silicon plastic encapsulation.

## FULLY TESTED AND MARKED SEMICONDUCTORS

	£p		£p
AC107	0-15	OC170	0-23
AC126	0-15	OC171	0-23
AC127	0-17	OC200	0-25
AC128	0-15	OC201	0-25
AC176	0-20	2G301	0-13
ACY17	0-20	2G303	0-13
AF239	0-30	2N711	0-50
AF186	0-20	2N1302-3	0-15
AF139	0-30	2N1304-5	0-17
BC154	0-20	2N1306-7	0-20
BC107	0-10	2N1308-9	0-22
BC108	0-10	2N3819FET	0-45
BC109	0-10		
BF194	0-15	<b>Power Transistors</b>	
BF274	0-20	OC20	0-50
BFY50	0-15	OC23	0-30
BSY25	0-13	OC25	0-25
BSY26	0-13	OC26	0-25
BSY27	0-13	OC28	0-30
BSY28	0-13	OC35	0-25
BSY29	0-13	OC36	0-37
BSY95A	0-10	AD149	0-30
OC41	0-15	AU110	1-25
OC44	0-13	25034	0-25
OC45	0-10	2N3055	0-50
OC71	0-10		
OC72	0-10	<b>Diodes</b>	
OC81	0-13	AAY42	0-10
OC81D	0-13	OA95	0-09
OC83	0-18	OA79	0-09
OC139	0-13	OA81	0-09
OC140	0-15	IN914	0-07

## F.E.T. PRICE BREAKTHROUGH !!

This field effect transistor is the  
2N3823 in a plastic encapsulation,  
coded as 3823E. It is also an excel-  
lent replacement for the 2N3819.  
Data sheet supplied with device.  
1-10 30p each, 10-50 25p each,  
50+20p each.



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NPN/PNP Silicon Planar Transistors, mixed, untested,  
similar to 2N706/6A/8, BSY26-29, BSY95A, BCY70, etc.  
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3823E Field effect Transistors. This is the 2N3823 in  
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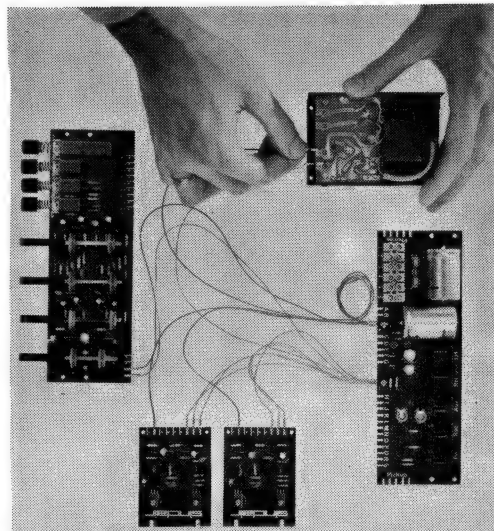
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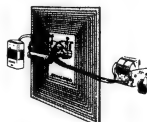


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AC128	12p	BC148	13p	BZ13	20p	OC82	12p	2N2926G	9p
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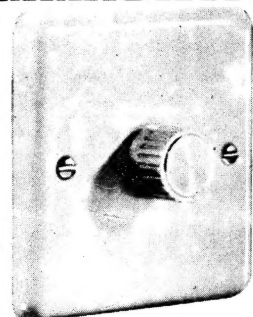
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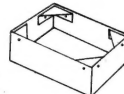
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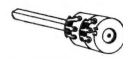
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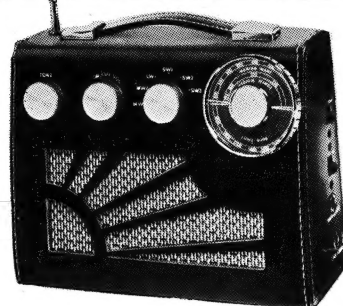
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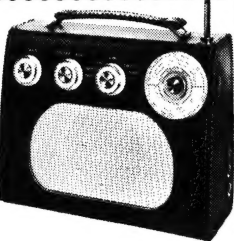


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7 Tunable Wavebands: MW1, MW2, LW, SW1, SW2, SW3 and Trawler Band. Built in Ferrite Rod Aerial for MW and LW. Retractable chrome plated Telescopic aerial for Short Waves. Push pull output using 600mw transistors. Car aerial and Tape record sockets. Selectivity switch. Switched earpiece socket complete with earpiece. 8 transistors plus 3 diodes. 8" x 2 1/2" Speaker. Air spaced ganged tuning condenser. Volume on/off, tuning, wave change and tone controls. Attractive case in rich chestnut shade with gold blocking. Size 9 x 7 x 4in. approx. Easy to follow instructions and diagrams. Parts Price List and Easy Build Plans 25p (FREE with parts).

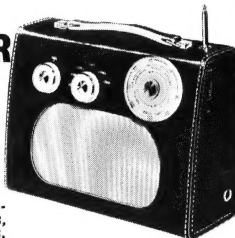
Total building cost **£6-98** P. P. & Ins. 41p.  
(Overseas P. & P. £1)



## ROAMER SEVEN MK IV

7 Tunable Wavebands: MW1, MW2, LW, SW1, SW2, SW3 and Trawler Band. Extra Medium waveband provides easier tuning of Radio Luxembourg, etc. Built in ferrite rod aerial for MW and LW. Retractable 4 section 24in. chrome plated telescopic aerial for SW. Socket for Car Aerial. Powerful push-pull output. 7 transistors and 2 diodes, including Micro-Alloy R.F. Transistors. 8" x 2 1/2" speaker. Air spaced ganged tuning condenser. Volume on/off, tuning and wave change controls. Attractive case with carrying handle. Size 9 x 7 x 4in. approx. Easy to follow instructions and diagrams. Parts price list and easy build plans 15p (FREE with parts). Earpiece with plug and switched socket for private listening, 30p extra.

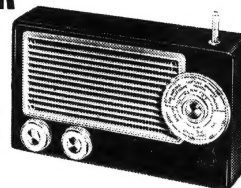
Total building costs **£5-98** P. P. & Ins. 41p.  
(Overseas P. & P. £1)



## ROAMER SIX

6 Tunable Wavebands: MW, LW, SW1, SW2, Trawler band plus an extra M.W. band for easier tuning of Luxembourg etc. Sensitive ferrite rod aerial and telescopic aerial for Short Waves. 3in. Speaker. 8 stages—8 transistors and 2 diodes including Micro-Alloy R.F. Transistors, etc. Attractive black case with red grille, dial and black knobs with polished metal inserts. Size 9 x 5 1/2 x 2 1/2in. approx. Easy build plans and parts price list 15p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

Total building costs **£3-98** P. P. & Ins. 26p  
(Overseas P. & P. £1)



## POCKET FIVE

3 Tunable Wavebands: MW, LW, Trawler Band with extended M.W. band for easier tuning of Luxembourg, etc. 7 stages—5 transistors and 2 diodes, supersensitive ferrite rod aerial, fine tone moving coil speaker. Attractive black and gold case. Size 5 1/2 x 1 1/2 x 3 1/2in. Easy build plans and parts price list 10p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

Total building costs **£2-23** P. P. & Ins. 21p  
(Overseas P. & P. 63p)

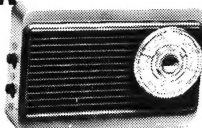


## TRANSONA FIVE

**5 TRANSISTORS AND 2 DIODES**

3 Tunable Wavebands: MW, LW and Trawler Band. 7 stage—5 transistors and 2 diodes, ferrite rod aerial, tuning condenser volume control, fine tone moving coil speaker. Attractive case with red speaker grille. Size 6 1/2 x 4 1/2 x 1 1/2in. Easy build plans and parts price list 10p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

Total building costs **£2-50** P. P. & Ins. 22p  
(Overseas P. & P. 63p)

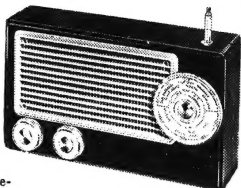


## TRANS EIGHT

**8 TRANSISTORS and 3 DIODES**

6 Tunable Wavebands: MW, LW, SW1, SW2, SW3 and Trawler Band. Sensitive ferrite rod aerial for M.W. and L.W. Telescopic aerial for Short Waves. 3in. Speaker. 8 improved type transistors plus 3 diodes. Attractive case in black with red grille, dial and black knobs with polished metal inserts. Size 9 x 5 1/2 x 2 1/2in. approx. Push pull output. Battery economiser switch for extended battery life. Ample power to drive a larger speaker. Parts price list and easy build plans 25p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

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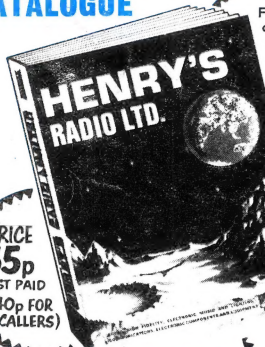
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